Effect Of Determinants Of Infant And Child Mortality In Nigeria: Hazard And Odds Ratio Models

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Abstract

Infant and child mortality is a major public health problem; however, quantifying its burden in a population is a challenge. Routine data collected provided a proxy for measuring the incidence of mortality among children under five years of age and for crudely estimating mortality rate. The data collected from National Demography Health Survey [NDHS, 2013] were used to investigate the determinants of infant and child mortality in Nigeria. Cox proportional, logistic model were developed to timely hazardously and probabilistically continuous variable, mother age and other specific covariates such as educational level, household income level, residence type and place of delivery which are categorical data.The Cox proportional analysis showed that the hazard risk and odds ratios of infant and child mortality are significantly less frequent over specified covariates, insignificant in residence type but significant in odds ratio. Also, there is an increased risk of infant and child mortality in place of delivery. It is evident from the results obtained that social economic risk factors contribute significantly to infant and child mortality in Nigeria. Finally these findings revealed that Mothers' educational level determines place of delivery (home, health centre) which should be improved; increase in household income contributes to child survival and reduces child mortality in Nigeria

Key words: odds ratio, hazard ratio, mortality

Introduction

One of the Millennium Development Goals is the reduction of infant and child mortality by two-thirds by 2015. Infant and child mortality in the agenda of public health and international health organizations has received attention as a part of millennium goal. In order to achieve this goal, all the countries of the world have been trying their best to determine the major factors responsible this and also put efforts towards identifying cost-effective strategies as many international agencies have advocated for more resources to be directed to health sector. Universally, there is huge literature that focused on the determinants of infant and child mortality. A great deal of efforts were made to target communicable diseases as majors determinants of Infant Mortality(IM) such as malaria, measles, diarrhea, respiratory infections and other immunisable childhood infections(Mutunga, 2004); however, it was noticed later that disease oriented vertical programmes were not adequate to reduce IM. Most of the studies have shown significant association between socioeconomic, demographic factors and infant-child mortality.

Ksenhya [7] categorized environmental health risks into traditional hazards related to poverty and lack of development, such as lack of safe water, inadequate sanitation and inadequate waste disposal, indoor air pollution, food contamination, occupational injury hazard, natural disasters and modern hazards such as urban air pollution, water pollution, solid and hazardous waste accumulation, chemical and radiation hazards, infectious disease hazards, ecological changes and climate changes. WHO (2002) reported that among the 10 identified leading mortality risks in high-mortality developing countries, unsafe water, sanitation and hygiene, indoor smoke from solid fuels. About 3% of these deaths (1.7 million) are attributable to environmental risk factors and child deaths account for about 90% of the totalpopulation.

In Kenya, it was reported that there was inconsistent relationship between socioeconomic status (measured by wealth index) and infant mortality(Hishma and Clifford 2008). The results indicate that sanitation, education and per capita income contributed to the decline in infant mortality in Brazil, the effects being stronger in the long run than in the short run. The fixed effects associated with municipality characteristics help explain the observed dispersion in child mortality rates [4].The proximate determinants are found to have stronger influence on under-five mortality than the socioeconomic factors considered in the study carried in Bangladesh (Chowdhury, 2013).Pandey and Manoj (2009) reported a strong association between maternal health and child mortality in rural India; the effects of maternal height, weight, presence of any disease and anemia were found significant.

Ghenga*et.al,* [5] revealed that maternal, child and family were important risk factors of U5M in Nigeria using multivariate logistic method of analysis . The following factors were included in the study: Maternal (current age, education, occupation, parity, marital status, age at first marriage, family planning, preceding birth interval, breastfeeding and health seeking behaviour); Childhood (sex, birth order, birth weight); Household (family size, sanitation number of wives, wealth index, fuel and water sources); Paternal factors (age, occupation); and other factors (place of residence, ethnicity and geopolitical region).

Uddin *et.al*, (2009) investigated the predictors of child mortality using cross tabulation and multiple logistic regression and reported that father's education and occupation of father, mother standard of living index, breastfeeding status, birth order have impact on child mortality

Zerai [10] examined socio-economic and demographic variables in a multi-level framework to determine conditions influencing infant survival in Zimbabwe. He employed Cox regression analysis to the 1988 Zimbabwe DHS data to study socioeconomic determinants of infant mortality; and Joshua*et.al*, [6] showed that the strength of the relationships of the independent (maternal, socioeconomic and sanitation) variables with the dependent variables (infant and child mortality) remain much smaller in the 2005-06 ZDHS survey than in the other ZDHS surveys. They employed multivariate Proportional Hazards Regression

Table 1. Absolute and percent distribution of explanatory covariates

Variables	Frequency	Percentage
Childmortality		
dead	2,886	9.17
alive	28, 596	90.83
Education level		
No education	14762	46.89
Primary education	6432	20.43
Seceondary education	8365	26.57
Higher education	1923	6.11
Residence type		
Urban	21,131	67.12
Rural	10,351	32.88
Household income		
Starved	7,076	22.48
Poor	7386	23.46
middle	6272	19.92
Rich	5806	18.44
Very rich	4942	15.70
Place of delivery		
Delivery at home	19619	62.32
Delivery at health centre	11512	36.57
Others	351	1.11
Age of respondents		
Less than 20	18,665	59.29
Between 20 and 29	12,009	38.15
Between 30 and 39	794	2.52
Between 40 and 49	14	0.04

Table1. The total number of children born alive was 28, 596while dead were 2,886with 90.83 and 9.17 percent respectively, for the distribution of explanatory variables over the total sample at risk in the overall mothers' age interval 0-49months

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Table 2.Descriptive Study Of Childmortality With Percentage

Factors	Infant and Child Mortality		Total
Age of respondent	Dead	Alive	
Less than 20 years	1912(6.07%)	16753(53.22)	18665
Between 20 and 29	916(2.91))	11093(35.24)	12009
Between 30 and 39	57(0.18)	737(2.34)	794
Between 40 and 49	1 (0.03%)	13(0.04)	14
Total	2886(9.17)	28596(90.83	31 482
Residence type			
Urban	2220 (7.05)	18 911(60.07)	21 131
Rural	666 (2.12)	9685(30.76)	10 351
Total	2886(9.17	28 596(90.83	31 482
Education level			
No education	1657 (5.26)	13 105(41.63)	14 762
Primary education	596 (1.89)	5836(18.53)	6432
Secondary	547(1.74)	7818(24.83)	8365
education	86 (0.27))	1837(5.84)	1923
Higher education	2886(9.17)	28 596(90.83)	31482
Total			
Place of delivery			
Delivery at home	1970 (6.26)	17649(56.06)	19,619
Delivery at health	778(2.47)	10734(34.10)	11,512
centre	138(0.44)	213(0.68)	351
Others	2886	28 596	31482
Total			
Household income			
Starved	835(2.65)	6241(19.82)	
Poor	887(2.82)	6499(20.64)	
Middle	502(1.60)	5770(18.33)	
Rich	412(1.31)	5394(17.13)	
Very Rich	250(0.79)	4692(14.90)	
Total	2886(9.17)	28596(90.83)	

A total of 2886 deaths were registered among 3142 children hospitalised for study in 2013. Table 1shows the proportion of infant and child that died at different covariate levels. The proportion varies with age of respondent, type of residence, level of education, place of delivery distance. The number of infant and child mortality decreased as the age of mother increased. It drops from 66.25% in the age of mother <20 year to 31.74% at age of between 20-29 years and also decreased in the 30–39 years groups to 1.98% and further decreased in the age of between 40-49 to 0.04%. The number of infant and child mortality is relatively more in the urban(76.92%) than rural(23.04%) area in relation to the total number people leaving in those areas.

Percentage of death recorded when mother has no education was 57.42% and drastically reduced when they had higher education with 2.98%. The death recorded when delivery was taken at home was 68.26% with total number of 19619 mothers as respondents; and at health centre 26.96% with total number of 11512 mothers**.**

Methods And Models

In this section we present our model for describing infant and child mortality. We employmultiple logistic regressions to investigate predictors of infant and child mortality and also consider cox regression for which the goal is to investigate the effect of a covariate of interest, mother' age(x_1), on time failure, possibly adjusted for other predictors variables place of delivery, education level, income level and place of birth, and region. For continuous covariate, mother' age, the effect is measured as a hazard ratio. This hazard ratio is associated with one unit increase in mother age , when the other covariate are held constant and for a binary predictor, the effect is a ratio of hazards or log hazards corresponding to two categories of continuous covariate when other covariates are held constant.

In a cox PH model, Cox regression is used to analyze time-to-event data, that is, the response is the time an individual takes to present the outcome of interest. Individual infant and child that die are assigned the total length of time of the follow-up when they are alive assigned the time of the end of the follow-up. Cox regression estimates the hazard rate function that expresses how the hazard rate depends upon a set of covariates. The model formulated is

$$h(t) = h_0(t)\exp(\beta_1 \text{mother's age} + \beta_{2\,\text{place of delivery}} + \beta_3 \text{education level} + \beta_4 \text{income level} + \beta_5 \text{place of birth} + \beta_6 \text{region})$$

where no distributional assumption is made about the baseline hazard, $h_0(t)$. Under the assumption the regression coefficient, β_1, is the log hazard ratio, ln (Δ), the change, associated with one unit increasein mother age when the other predictors are held constant, and the exponentiated regression coefficient, $\exp(\beta_1)$, is the hazard ratio, Therefore, the effect of mother age on time to failure can be investigated by performing an appropriate test based on the partial likelihood (Hosmer Jr., Lemeshow, and May 2008; Klein and Moeschberger 2003) for the regression coefficient, β, from a Cox model. . We focus on children that are born alive by estimating the probability of a child dying within the mother next birthday after surviving(cuddling/attention/ health care/ mother care) for tyear, as a result of environmental factors..The mortality rate of child at mother age t can be interpreted as the intensity at which a child dies at this age, given that the child survived until mother age

In logistic regression model**,** given a set of observations $(y_i, \mathbf{x}_i)$, $i = 1, \cdots, n$, where y_i is a binary response such that $y_i = 1$ if a child died and $y_i = 0$ a child lived, and $\mathbf{x}_i = (x_{i1}, \cdots, x_{ip})'$ are covariates, we consider a multiple logistic model to estimate the probability of dying , $y_i = 1$ versus the probability of being alive, $y_i = 0$. The response is distributed as a Bernoulli random variable in which fitted response function defined is $\pi_i = [1 + \exp(-X_i' b)]^{-1}$, Where $X_i' b = b_0 + b_{1\,\text{motherage}\,i1} + b_{2\,\text{educational level}\,i2} + b_{3\,\text{income}\,i3} + b_{4\,\text{place of delivery}\,i4} + b_{5\,\text{residence}\,i5}$. Odd ratio model $= \frac{\pi_i}{1 - \pi_i}$

Discussion of Results

This study investigates the predictors of child mortality in Nigeria. It utilizedthe nationally representative data from the National Demographic Health Survey(NDHS, 2013. Cox Proportional and Logistic regressiontechnique were used to ascertain the effect of predictors of infant and childmortality. From these analyses several interesting observation can be made, although the analysis itself was subject to various types of problem. Sometimes, it is observed that logical or theoretical hypothesis is supported by the results of fittedhazard and logistic response function.

Logistics revealed that infant and child mortality significantly decreased as a result of unit change in educational level(No education, Primary education, Secondary education and Higher education) by 17%, household income(Starved, Poor, Middle, Rich and Very Rich) by 15%, residence(urban and rural**)** by 20% and mother age by 10%.However, infant and child mortality significantly increased as a result of unit change in place of delivery(Delivery at home, Delivery at health centre and Others) by 46%. Cox proportional also revealed that educational level at 17%, household income at 16%, residence type at 13% significantly decreased risk, and residence type at 13% significantly decreased risk, while place of delivery at 42% significantly increased risk (with hazard ratio of one, indicating the chance of infant and child not being alive) of not infant and child mortality as mother's age increases.

So, urgent attention should begiven to place of delivery and other factors in order to further reduce the risk of infant and childmortality in Nigeria.

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Appendix 1Appendix 2

		σ=1					σ=5
0.99	0.999	0.8	0.9	0.95	0.99	0.999	0.8
22.661	248.616	0.985	2.043	4.315	24.262	266.182	3.03
0.380	0.374	0.512	0.433	0.397	0.376	0.370	0.47
1.003	0.998	0.773	0.831	0.915	0.974	0.966	0.73
0.538	0.764	0.529	0.443	0.424	0.529	0.744	0.50
0.975	0.996	0.664	0.687	0.795	0.947	0.964	0.65
0.878	0.980	0.846	0.722	0.721	0.859	0.949	0.81
1.003	0.998	0.773	0.831	0.915	0.974	0.966	0.73
0.880	0.982	0.571	0.590	0.663	0.859	0.951	0.61
0.975	0.996	0.664	0.687	0.795	0.947	0.964	0.65
0.773	0.952	0.682	0.605	0.611	0.760	0.925	0.72
0.921	0.988	0.896	0.840	0.822	0.898	0.957	0.93
0.830	0.972	0.522	0.535	0.600	0.811	0.942	0.56
0.887	0.985	0.789	0.704	0.705	0.864	0.954	0.83
0.397	0.398	0.439	0.404	0.394	0.394	0.395	0.45
0.993	0.997	0.805	0.804	0.872	0.964	0.965	0.80
0.627	0.832	0.486	0.442	0.464	0.616	0.809	0.47
0.961	0.995	0.691	0.665	0.750	0.933	0.963	0.69
0.595	0.736	0.479	0.472	0.493	0.588	0.721	0.57
0.968	0.996	0.857	0.812	0.834	0.940	0.964	0.88
0.748	0.927	0.467	0.471	0.531	0.733	0.899	0.49
0.932	0.993	0.738	0.670	0.715	0.905	0.961	0.76
0.628	0.667	0.451	0.458	0.514	0.621	0.654	0.54
0.951	0.995	0.818	0.760	0.785	0.922	0.963	0.84
0.750	0.900	0.468	0.470	0.542	0.736	0.875	0.50
0.925	0.992	0.714	0.647	0.694	0.898	0.961	0.73
10.031	106.098	0.482	0.956	1.947	10.338	109.346	0.95
0.386	0.446	0.636	0.522	0.447	0.393	0.385	0.61
0.923	0.855	0.769	0.743	0.810	0.969	0.986	0.80
0.458	0.634	0.662	0.537	0.456	0.470	0.684	0.65
0.866	0.853	0.727	0.649	0.677	0.909	0.981	0.75
0.784	0.839	1.057	0.814	0.736	0.821	0.956	1.01
0.923	0.855	0.769	0.743	0.810	0.969	0.986	0.80
0.758	0.837	0.608	0.569	0.601	0.793	0.955	0.65
0.866	0.853	0.727	0.649	0.677	0.909	0.981	0.75
0.677	0.797	0.824	0.666	0.617	0.704	0.913	0.79
0.814	0.820	0.927	0.864	0.805	0.844	0.958	0.92
0.700	0.820	0.574	0.526	0.546	0.730	0.937	0.61
0.751	0.828	0.863	0.765	0.687	0.780	0.954	0.85
0.395	0.460	0.531	0.455	0.418	0.402	0.404	0.55
0.897	0.854	0.841	0.772	0.777	0.942	0.985	0.85
0.527	0.714	0.602	0.499	0.455	0.544	0.765	0.60
0.835	0.851	0.775	0.673	0.653	0.876	0.979	0.79
0.541	0.670	0.537	0.489	0.489	0.556	0.697	0.60
0.858	0.852	0.897	0.823	0.778	0.895	0.979	0.89
0.627	0.780	0.544	0.481	0.485	0.650	0.877	0.58
0.790	0.847	0.824	0.717	0.655	0.828	0.973	0.82
0.583	0.647	0.527	0.470	0.477	0.600	0.659	0.57
0.821	0.852	0.864	0.772	0.718	0.857	0.976	0.87
0.641	0.770	0.563	0.489	0.487	0.664	0.853	0.59