Multilevel Analysis of Factors Associated with Child Mortality in Uganda.

Alex Mugarura[14] and Will Kaberuka[15]

Abstract

The purpose of this paper is to examine the effect of factors associated with child mortality in Uganda. The Demographic and Health Survey data set (2006) is used to investigate these factors. A random effects regression model and logistic regression model were fitted to establish the significant factors affecting child mortality. The paper considers two types of factors which are maternal Factors (Education level, age of mother, wealth of household) and child factors (birth order, weight of child, Sex of a child, and duration of breastfeeding). Sex, birth weight, Education level, age of mother and household wealth were found to be important predictors of child mortality. However, controlling for mother level factors in model II, the within childhood characteristics were highly correlated. From an explicit multilevel analytic framework, the study therefore demonstrates that individual (child) and mother level characteristics are independent predictors of child mortality; and that there is significant variation in odds of reporting child mortality, even after controlling for effects of both child and mother-level characteristics. The p - values in the random effects model were small compared to the p – values of a standard logistic model. The results of random effects model are more statistically significant than those of a standard logistic regression model. Therefore, the random effects regression model is recommended as an appropriate alternative to standard logistic regression in order to account for variations due to a hierarchical structure.

Keywords: Hierarchical structure, Child Mortality, Random Effects Modal, Odds ratio, Uganda

[14] Makerere University Business School, Makerere University, Kampala, Uganda
[15] Makerere University Business School, Makerere University, Kampala, Uganda

1.0 Introduction

One of the demographic variables that affect population trends and of interest to demographers, policy makers and researchers is mortality because it is one of the indicators of socio-economic development. World Health Organization (WHO), 2005 reported that 10.8 million children under age five die every year. Four million of those children die within the neonatal period (1st month of life). In Kenya, studies on child health have focused on medical causes of infant and child mortality (McElroy et al, 2001). These studies revealed that newborn' health is closely linked to that of their mothers. Therefore, newborn babies have unique needs that must be addressed in the context of maternal and child health services.

According to UNICEF (1999), the decline in child mortality in Africa has been slower since 1980 than in the 1960s and 1970s. Of the thirty countries with the world's highest child mortality rates, twenty-seven are in sub-Saharan Africa. Through the provision of better healthcare services, infant and under-five mortality rates have declined from 129.1 and 147.2 to 84.7 and 82.9 deaths per 1,000 live births, respectively over the decades (Binka et al, 2007). Although the situation is much better than it was a decade ago, the level of childhood mortality is still quite high. Therefore, disentangling the effects of environmental and socio-demographic risk factors of mortality could lead to a better understanding of the forces underlying childhood mortality and help child survival intervention program managers to prioritize and target children who are at most risk.

In 2006, 9.7 million children under five died and that is a 60% decline since 1960 (UNICEF, 2008). About half of the child deaths occur in Africa, according to UNICEF (2006) and UBOS (2006), Uganda has had significant growth in the economy over the last decade with an average annual GDP growth rate of 6.6 per cent (World Bank, 2008). However, there are increasing concerns that most social indicators including infant and child mortality rate have not improved over these years. The infant and child mortality rate of the country still remain one of the highest both in the African and the world at 134/1000 live births in 2006 (World Development Indicators, 2006).

If Uganda is committed to achieving the MDG on child mortality and to improve child health, there is need to understand clearly the factors that are contributing to child mortality and the need to examine the effect of child and mother characteristics on child survival. Demographic and health survey data as used for child mortality analysis have a hierarchical structure. A multilevel analysis also referred to as a hierarchical model can account for the lack of independence across levels of nested data. Conventional regression assumes that all experimental units are independent in the sense that any variable affecting child mortality has the same effect in all families. A multilevel modeling relaxes this assumption and allows these variables' effects to vary across the families. Therefore this study explores the hierarchical structure at child and mother unit levels of analysis and examines the effect of mother characteristics on childhood mortality.

The remainder of this study is organized as follows. Section 2 reviews the literature. Section 3 spells out type of data and analysis. Section 4 presents and discusses the results. Section 5 gives conclusions and recommendations.

2.0 Literature Review

Despite the evidence studies by some of the analyses on African data (Balk et al. 2004; Gakidou and King 2002), scientific knowledge on how community-level factors or Child's parents influence child survival remains fragmentary. Most studies have been restricted to the analysis of clustering at a single level (family or community), and thus have ignored the complete hierarchical structure of the data (Gibbons and Hedeker 1997). This study has filled this glowing gap by using a multilevel model to quantify the magnitude and importance of clustering mortality risks at the family and child levels. The model applied in this study has explicitly accounted for the unobserved heterogeneity within mothers of the children (Manda 1998).

Maternal factors; Maternal age has been observed as an important predictor of child mortality. Studies have shown that adolescents and older mothers are likely to produce infants of low birth weights. Ahonsi (1995) found that the risk of child mortality remained high to mothers in the teenage ages compared to those aged between 20 and 34 years. Aizenmande (1988) has also shown that IMR among children whose mothers are under 20 years of age is estimated at 126/1000 live births world over. However, Kibet (1987) indicated that there was an inverse relationship between the age of the mother and childhood mortality. Reichmann and Pagnini (1997) found the relationship differs by race in the United States, with a U-shaped relationship between the age of the mother and child mortality.

Studies conducted by Ahimbisibwe (1997) found a statistically significant relationship between childhood survival and age of the mother. Children born to older mothers (30 and above) in the study were found to have a higher risk of dying compared to those born to mothers in age group 25-30 years while Cleland et al (1988) observed that infants born to young mothers were at high risks of dying than those born to older mothers.

According to UNICEF (2003), it was revealed that births to mothers who had never been married had higher rates of child mortality. Carvajal and Burgress (1978) found that child deaths to children born to mothers who were living single lives were higher than those who were legally married. Although there is an inverse relationship between women's status and early childhood mortality, the relationship is not necessarily linear (UBOS, 2001). The marital status of a mother in a family can determine her decision power (Kaharuza et al, 2001).

Berrera (1990) and Basu, et al (2005) noted the importance of mother's education on child survival. It reflects mother's level of knowledge and skills and the degree to which she can effectively make use of the resources at her disposal to increase survival chances of her infants. Educated mothers may initiate changes in their family's personal hygiene, food preparation procedures and practices that are harmful to child health (Caldwell, 1979: UN, 1994). Women with more education increase their likelihood of securing a good job, have decision making power and control over resources (Frost, et al 2005). Also it was indicated that education equips women with great health knowledge (Bhuiya et al, 1990) and influences women attitude about health (Castro et al, 1995) and a woman is more likely to draw attention to their children's illnesses (Caldwell 1993). Educated mothers look for qualified medical personnel while seeking medical care for themselves and for children (Cleland et al, 1988).

In Bangladesh, it has been shown that children from poorer households tend to be more undernourished with increased risks of dying before 5 years of age than children in wealthier households (Zere et al, 2003). UBOS (2006) revealed that in Uganda wealth status is inversely associated with childhood mortality. For all measures, the children in the highest wealth index quintile have the lowest mortality rates, while those in the lowest wealth index quintile have the highest mortality rates.

Childhood factors; Socio-economic differences in the risk of dying are high among boys than girls and the differences reduced as children grew older (Hobcraft et al, 1984). It has been argued that the sex of the child contributes to child survival (Scrimshaw, 1978; Simmons et al., 1982). In Kenya, child survival rates are higher for females. And in South Asia, where female dowry is the main concern, the reverse is true (Mott, 1979; Poffenberger, 1981). However, it was observed that some societies may resort to intentional injury (infanticide) to achieve family size composition goals (Mosley et al, 1984). Ssewanyana, (2005) showed that girls have a somewhat lower IMR than boys. The difference ranges from 7 percent for post neonatal mortality to 14 percent for neonatal mortality (UBOS, 2001).

The infants weighing less than 2,500g are approximately 20 times more likely to die than heavier babies. More common in developing countries like Kenya, Uganda and Malawi than developed countries, a birth-weight below 2,500g contributes to a range of poor health outcomes (UNICEF, WHO, 2004). According to Mosley et al (1984), a significant relationship of birth weight and weight for age as an indicator of general health was found to exist from prospective studies in Bangladesh, India, and New Guinea. In Uganda, It was shown that babies who were reported as small or very small at birth have higher mortality rates than those who were reported as average or large at birth (UBOS, 2001).

Usually the relationship between birth order and mortality at early age takes a U-shaped form. Birth order and survival status of the preceding child have a strong association with infant mortality in Africa and Asia as well (Keonig, 1990). The mother's nutritional status, which affects birth weight and lactation, may decrease with high-order births (Norman et al, 2008). However, it is observed that in Bangladesh, neonatal and post-neonatal mortality level is the lowest for 4th and above order of births than first, second and third order of births (Nazrulet al, 2009).

Increasing the duration and exclusivity of breastfeeding could save an estimated 1.5 million infant lives each year (WHO, 2001). Fifty five percent of infant deaths from diarrhoeal diseases and acute respiratory infectious may result from inappropriate feeding practices (UNICEF, 1999). The risk of death due to diarrhoea among predominantly breastfed infants was also higher but not statistically different from that of exclusively breastfed infants (Jason et al, 1984).

3. 0 Data Type and Analysis

Data from the Uganda Demographic and Health Survey (2006) is used in this study. The study covers the whole of Uganda. From the data, information about the children and their mothers who were born 5 years before the survey was obtained.

The dependent variable was childhood survivorship; the variable gave a binary outcome; a child born survived to the 5th birth-day; coded zero (0) or died before his/her 5th birth-day coded one (1). The independent variables included; sex of the child, birth weight, birth order, and duration of breastfeeding as child level factors; education level, household wealth, age of the mother and marital status as mother level factors.

Data analysis was done at three levels using STATS; Univeriate, Bivariate and Multivariate. Descriptive statistics were presented using frequency tables; testing for associations, between two variables was done using the chi-square, while multivariate level of analysis, logistic regression modal was fitted.

As mentioned above, the outcome variable is a binary outcome; therefore a hierarchical or multilevel mixed effects logistic regression model was used in the analysis. For the i th observation in the j th mother, we observe a dichotomous response:

Y_{ij} = 1, for a child who survived up to at least 5 years

0, otherwise.

We assume that Y_{ij}/P_{ij} = Bernoulli (P_{ij}) (1)

Independently for i= 1, 2 … n_j and j= 1, 2, 3 ….N, where P_{ij} =Pr (Y_{ij} =1) is the probability that i th observation (child) will not survive up to at least 5years of age. Therefore, for the j th mother, the usual logistic regression will be:

$$\text{Logit}(P_{ij}) = \log\left(\frac{p_{ij}}{1-p_{ij}}\right) = \beta_0 + \beta_{ij} x_{ij} + \ldots + \beta_{kn} x_{kn} \qquad \text{(Model I)} \qquad (2)$$

Where; x_i are independent variables.

β_0 is a constant.

β_i are unknown coefficients of each x_i .

Assume there are j = 1,..., N mothers (level-2 units) and i = 1,...,n_j repeated observations (level-1 units) nested within each subject (mother). A random-effects regression model, which is the simplest mixed model, augments the linear predictor with a single random effect for the jth mother (McCullagh and Nelder, 1989) and therefore will have the following model.

$$\text{Logit}(P_{ij}) = \log\left(\frac{p_{ij}}{1-p_{ij}}\right) = \mathbf{X}_{ij}\boldsymbol{\beta} + \mathbf{V}_j + e_{ij} \qquad \text{(Model II)} \qquad (3)$$

Where

$\mathbf{X}_{ij}$ **=** the covariate matrix (includes a 1 for the intercept),

$\boldsymbol{\beta}$ **=** the vector of unknown regression parameters,

$\mathbf{V}_j$ **=** the random cluster effect (one for each level-2 cluster i.e. mother)

e_{ij} = the error term

$\mathbf{V}_j$ the random effect (one for each mother). These random effects represent the influence of j-th mother on her repeated observations (children) that is not captured by the observed covariates. These are treated as random effects because the sampled subjects (mothers) are thought to represent a different population of subjects (mothers).

Logistic regression measures the relationship between the categorical dependent variable and one or more independent variables assuming the data is from same population while a random effect(s) model, also called a variance components model, is a kind of hierarchical linear model. It assumes that the dataset being analysed consists of a hierarchy of different populations whose differences relate to that hierarchy.

4.0 Presentation and Discussion of the Results

4.1 Distribution of children by their characteristics

Table 1, **F**rom this table, about 33% of children born are recorded as large size thus indicating that most born babies were of small or average size at birth. This is an indication that in Uganda, mothers are not aware of the effect of the size of a child at birth on the child survival. The table also shows that 87 percent of the children born alive were breastfed up to 2 years, 5 percent were never breastfed at all while 42 percent of the total children born were of birth order 5 and above.

Table 1: Percentage distribution of respondents by child level factors

Variable	Frequency	Percentage
Sex of child		
Male	4145	49.5
Female	4224	50.5
Total	8369	100
Birth weight		
Large	2723	32.6
Average	3761	45.1
Small	1860	22.3
Total	8344	100
Duration of breastfeeding		
Up to 2 years	7261	87.4
More than 2 years	653	7.8
never breastfeed	396	4.8
Total	8310	100
Birth order		
1and 2	2649	31.6
3 and 4	2190	26.2
5+	3530	42.2
Total	8369	100

4.2 Relationship between the dependent variable and selected independent variables

4.2.1 Child factors

The study revealed that more childhood deaths occurred among males compared to their female counterparts as shown in table 2. It is also clear from table 2 that children born alive with small size are at high risks of dying before 5 years of age. Also most (58.8%) of children who were never breastfed died before age 5. In conclusion, the selected child level factors/variables in this study; Sex of child, Birth weight, Duration of breastfeeding, Birth order were all found to have a strong statistical significant relationships with child survivorship. All the p-values were less than the P=0.05.

Table 2: Relationship between the dependent variable and selected child level characteristics

Variables	Number of children	Number dead	% dead
Sex of child			
Male	4145	431	10.4
Female	4224	345	8.2
	χ^2 =12.3718, P=0.000, df=1		
Birth weight			
Large	2723	243	8.9
Average	3761	316	8.4
Small	1860	207	11.1
	χ^2 =11.4189, P=0.003, df=2		
Duration of breastfeeding			
Up to 2 years	7261	520	7.2
More than 2 years	653	4	0.9
Never breastfeed	396	233	58.8
	χ^2 =0.374, P=0.000, df=2		
Birth order			
1&2	2649	243	9.2
3&4	2190	200	9.1
5+	3530	333	9.4
	χ^2 =0.1908, P=0.309, df=2		

4.2.2 Mother factors

Table 3 showed a significant relationship between childhood mortality and age of the mothers (p=0.017). 12 percent of the children born to mothers in age group 40-49 died before age 5 compared to 8 percent of children born to mothers in age group 15-19 who died before age 5. Also 9 percent of children born to mothers in age group 20-29 died before age 5 compared to at least 9 percent of children born to mothers in age group 30-39 who died before age 5. The results in this study were in agreement with those of Ahimbisibwe (1997). 10 percent of children born to mothers with no education level died before age 5 compared to 5 percent of children born to mothers with higher (higher institutions) level of education who died before age 5. There was a significant relationship between education level of the mother and childhood survivorship as indicated in table 4.4 (p=0.001). 12 percent of children born to divorced/separated mothers died before age 5 compared to 9 percent of children born to married/cohabiting women who died before age 5. The chi-square statistic shows a significant relationship between childhood mortality and marital status (p=0.009).

Table 3: Relationship between the dependent variable and selected mother level characteristics

Household wealth	**Number of children**	**Number dead**	**%dead**
Poor	3959	407	10.3
Middle	1555	132	8.5
Rich	2855	237	8.3
	χ^2 =9.1175, Pr=0.010, df=2		
Marital status			
Never married	262	17	6.5
Married/cohabiting	7236	656	9.1
Divorced/Separated	871	103	11.8
	χ^2 =9.5295, Pr=0.009, df=2		
Education level			
No education	2034	210	10.3
Primary	5181	494	9.5
Secondary	959	63	6.6
Higher	195	9	4.6
	χ^2 =16.4567, Pr=0.001, df=2		
Age of the mother			
15-19	430	33	7.8
20-29	4357	411	9.4
30-39	2885	247	8.6
40-49	697	85	12.2
	χ^2 =10.2495, Pr=0.017, df=3		

Table 3 shows that 10 percent of children born to mothers in poor families died before age 5 compared to 8 percent of the children born to mothers in rich families who died before age 5. It was indicated from the chi-square statistic that the relationship between the household wealth and childhood mortality was significant (p=0.010).

4.3 Determinants of child death (regression results)

4.3.1. Standard logistic (binary) regression model

Table 4 gives results under model I. Variables; Age of Mother, Education level, household wealth, duration of breastfeeding, birth-weight and sex had significant relationships with child mortality. These results are almost the same as the results by model II. However, the p - values in the Model II are small compared to the p – values of the Model I. This means that the variables in the random effects model are more statistically significant than those in logistic model. This could be because the standard logistic model does not cater for the variation in mortality rates due to hierarchical structure in the data.

4.3.2 Random effects regression model

In order to establish the effect of each independent variable (factor) on childhood deaths in Uganda, a random effects regression model was fitted due to the type of data (nested data) used. Sex of a child shows a statistical significant relationship against child mortality. Female children had reduced risks of dying before 5 years of age compared to male children (OR=0.81832, p=0.017). Culturally, female children are considered to be of great importance since they are regarded as a source of wealth at marriage. Hence parents show much care to females than male children. This is similar to what happens elsewhere, for example in Kenya, where girls are valued for the bride price, child survival rates are higher for female (Mott, 1979) and Poffenberger, 1981).

In this study, children born to a mother of secondary level had reduced risks of dying before 5 years of age compared to children born to mothers with no education (OR= 0.6802, p=0.023). This is in line with the literature reviewed which showed that mothers who had primary and secondary level of education experienced fewer infant deaths. Also children born to mothers with higher level of education had reduced risks of dying before 5 years of age compared to children born to mothers with no education (OR= 0.3723, p= 0.016). These results are possible because a woman with some level of education, of at least secondary level, may be aware of the diseases caused by contaminated water thus able to use protected clean water, give good health care, get a job and be able to support the family in terms of provision of basic needs of life. This is becuase education equips women with great health knowledge (Bhuiya et al, 1990) and influences women attitude about health (Castro et al, 1995).

The duration of breastfeeding shows a statistical significant effect to childhood mortality. Children who breastfed for a period of more than 2 years had reduced risks of dying before 5 years of age compared to children who were breastfed for less or up to 2 years (OR=0.0856, P=0.000). Children who were never breastfed had increased risks of dying before 5 years of age compared to children who were breastfed for less or up to 2 years (OR=44.5142, P=0.000). This could be due to the fact that such a child would not be getting sufficient nutrients for body building. The nutrients from breastfeeding are supposed to supplement what the child gets from other foods and drinks. Therefore, children who lack such nutrients may have increased risks of dying before 5 years of age compared to those who are breastfeed. This is in agreement with the study by Ebrahim (1979).

Birth weight is found to be significant to child mortality. Children born when small had increased risks of dying before 5 years of age compared to children born when large (OR=1.2525, P=0.041). This situation is associated with premature birth (being born before 37 weeks of gestation) meaning that a baby has got less time in the mother's womb to grow and gain weight because of problems with the placenta, or the mother's health or birth defects. All these might lead to premature and weak born babies posing high risks of death among such children. Poor food supplements given to mothers during pregnancy might also lead to premature and weak born babies since child malnutrition is increasingly recognized to be largely determined during the period when the child is still inside the womb and infant growth, when maternal nutrition has its strongest influence. This is in agreement with studies by Mosley (1984) and UBOS (2001).

From Table 4, children born to mothers in age group 30-39 had reduced risks of dying before 5 years of age compared to children born to a mother in age group 15-19 (OR= 0.0943, p=0.034). Children born to a mother in age group 40-49 also had increased risks of dying before 5 years of age compared to children born to mother of age group 15-19 (OR= 1.5702, P=0.012). This could be exhibited by adolescent and older mothers who are likely to produce children of low birth weight which increases the risk of child death. This finding corroborates the works of Ahimbisibwe (1997). Furthermore, children born of older mothers (30 and above) in the study were also to have a higher risk of dying.

Table 4: The random effects and standard logistic (binary) regression models.

Variables	Model I Standard logistic regression model			Model II Random effects regression model		
	Odds Ratio	Std. Error	P-value	Odds ratio	Std. error	P-value
Sex						
Male	1			1		
Female	0.7554	0.0585	0	0.8183	0.0688	0.017
Birth weight						
Large	1			1		
Average	1.2842	0.1327	0.015	0.9105	0.0885	0.335
Small	2.0491	0.7293	0.044	1.2525	0.1378	0.041
Duration of breastfeeding						
Less or up to 2 years	1			1		
More than 2 years	0.7521	0.7763	0.006	0.0856	0.0505	0
Never breastfeed	2.5309	0.7172	0.001	4.5142	3.2639	0
Age of mother						
15-19	1			1		
20-29	1.1163	0.2725	0.058	1.1527	0.2431	0.005
30-39	0.7348	0.2296	0.04	0.0943	0.2197	0.034
40-49	1.2123	0.2621	0.46	1.5702	0.3832	0.012
Education level						
No education	1			1		
Primary	0.9864	0.0921	0.883	1.0115	0.1045	0.912
Secondary	0.6871	0.1137	0.033	0.6802	0.1229	0.023
Higher	0.4839	0.1736	0.042	0.3723	0.1532	0.016
Household wealth						
Poor	1			1		
Middle	0.7952	0.0368	0.046	0.7834	0.0932	0.032
Rich	0.8953	0.0841	0.042	0.8462	0.0881	0.041
Random-effects parameters				**Estimate**	**Std. error**	
Caseid:						
Exchangeable						
Sd.				0.38978	0.062164	
Corr.				0.999994	0.011251	

Household wealth shows a statistical significant relationship with child survival. From table 4 above, children born to a mother in a rich family had reduced risks of dying before 5 years of age compared to children born to a mother in a poor family (OR= 0.8462, P=041). Children born to a mother in a middle class family had reduced risks of dying before 5 years of age compared to children born to a mother in a poor family (OR= 0.7834, P=0.032). This is in conformity with the study by Zere et al (2003) in Bangladesh. The study indicated that children from poor households tend to be more undernourished with increased risks of dying before 5 years of age than children in wealthier households. This could be because mothers from rich families can afford basic requirements such as protected source of water, medical care and sufficient food/nutritional requirements needed for proper child health than those children of mothers in poor families who are unable to provide such basic necessities.

Random effects parameters

From the study, a significant relationship between-mother random variation was found [σ=0.3898]. Having controlled for mother level factors, the within childhood characteristics were found to be highly correlated (on average 0.999). This means that mortality rates of children are highly influenced by mother level characteristics. It is likely that there are other biological or precipitating/prognostic factors affecting mortality differently in different mothers. This variation could be possible as mothers can be of the same age group but staying in different areas and having different standards of living or be in same age group but having different education levels which may bring different understanding (knowledge) about the health of child. Using an explicit multilevel analytic framework, the study has demonstrated that individual (child) and mother level characteristics are independent predictors of child mortality, and that there is significant variation in odds of reporting child mortality, even after controlling for effects of both child and mother-level characteristics which would not be observed by using the standard logistic regression model.

5. Conclusions and recommendations

5.1 Conclusions

The study looked at the factors associated with childhood mortality in Uganda. An in-depth analysis was carried out to determine which level variables tend to put children at higher risks of death. Using a random effect model, Sex of a child, duration of breastfeeding, birth weight, education level, age of mother, household wealth were found to be important determinants of child mortality. However, the within childhood characteristics were seen to be highly correlated. This means that mortality rates of children are highly influenced by mother level characteristics. It is likely that there are other biological or precipitating/prognostic factors affecting mortality differently in different mothers. The study demonstrated that individual (child) and mother level characteristics are independent determinants of child mortality, and that there is significant variation in odds of reporting child mortality, even after controlling for effects of both child and mother-level characteristics which would not be seen by using the standard logistic regression model. The results of the Standard Logistic regression model were a bit different from the results of the random effects model. The variables in the random effects model are more statistically significant than those in a standard logistic regression model due to lack of independence of variables in the standard logistic regression model or variation in mortality rates due to hierarchical structure in the data.

5.2 Recommendations

Random effects model should be used when demographic and health survey data are used for child mortality analysis due to their hierarchical structure of the data. This is because multilevel modelling has the advantage of taking the hierarchical structure of such nested data into account.

REFERENCES

Ahimbisibwe, F.E., (1997). "Environmental sanitation and maternal factors as the determinants of infant mortality in Ankole". MA Dissertation, Makerere University, Kampala.

Ahonsi B, A (1995) "Age Variations in the Proximate Determinants of Child Mortality in South-West Nigeria" *Journal of Biosocial Science.* Vol 27 (01) Pp 19 – 30

Aizenman DE. (1988) "Impact of Family Planning ob Maternal-child Health: The future of humanity depends on our children" *Profamilia: planificación, población y desarollo,* Vol 4(13): Pp. 28-33.

Balk, D., T. Pullum, A. Storeygard, F. Greenwell, and M. Neuman. (2004). "A Spatial Analysis of Childhood Mortality in West Africa" *Population, Space and Place* Vol 10: Pp 175-216.

Barrera, A. (1990). "The role of maternal schooling and its interaction with public healthprograms in child health production" *Journal of Development Economics*,Vol 32(1), Pp 69-91.

Basu, A., & Stephenson, R. (2005). "Low Levels of Maternal Education and the proximate determinants of childhood mortality: a little learning is not a dangerous thing." *Social Science & Medicine*, Vol 60; Pp 2011-2023.

Bhuiya A, Streatfield K & Meyer P (1990) "Mother's hygienic awareness, behavior, and Knowledge of major childhood diseases in Matlab Bangladesh." In J Caldwell, S Findley, P Caldwell, G Santow, W Cosford, J Braid & D Broers-Freeman (Eds) *What we know about health transition: The cultural, social, and behavioural determinants of health Canberra:* The Australian National University Printing Service

Binka FN, et al. (2007) "Rapid achievement of the child survival millennium development goal: evidence from the Navrongo experiment in Northern Ghana." *Tropical Medicine & International Health*. Vol 12: Pp 578–583

Caldwell J C. (1993) "Health transition: The cultural, Social and behavioral determinants of health in the Third World." *Social Science and Medicine*. Vol 35: Pp 125-135

Caldwell, J. (1979). "Education as a factor in mortality decline: An examination of Nigerian data." *Population Studies*, Vol 33, Pp 395-413.

Carvajal, M. and Burgress, P. (1978), "Socio-Economic Determinants of Fetal and Child deaths in Latin America: A Comparative Study of Bogota, Caracas and Rio de Janeiro," *Social Science and Medicine,* Vol 12: Pp 89-98.

Castro Martin T & Juarez F (1995) "The impact of women's education on fertility in Latin America: Searching for explanations," *International Family Planning Perspectives*; Vol.27; Pp 1357-1368

Cleland, J.G. and Van Ginneken, J.K. (1988). "Maternal education and child survival in developing countries: The search for pathways of influence." *Social Science and Medicine*; Vol. 27(12): Pp 1357-1368

Frost, M. B., Forste, R., & Haas, D. W. (2005). "Maternal education and child nutritional status in Bolivia: Finding the links" *Social Science and Medicine*, Vol 60; Pp 395-407.

Gakidou, E. and G. King. (2002). "Measuring Total Health Inequality: Adding Individual Variation to Group-Level Differences" *International Journal for Equity in Health;* Vol. 1(3)

Gibbons, R.D. and D. Hedeker. 1997. "Random Effects Probit and Logistic Regression Models for Three-Level Data." *Biometrics* Vol 53: Pp 1527-1537.

Hobcraft, J.N, McDonald, J.W., and Rutstein, S.O. (1984). "Socio-economic factors in infant and child mortality: A cross national comparison." *Population Studies*; Vol. 38(2): Pp 193-223

Jason, J, Nieburg, P, Marks, J. (1984). "Mortality and infectious disease associated with infant feeding practices in developing countries" *Paediatrics*. Vol. 74: Pp 702-727

Kaharuza F, Sabroe S, Scheutz, F (2001) "Determinants of child mortality in a rural Ugandan community". *East African Medical Journal*; Vol. 78(12): Pp 630-5.

Koenig M. A, Phillips J. F, Campbell O. M and S. D'Souza, (1990) "Birth Intervals and Childhood Mortality in Rural Bangladesh" *Demography*, Vol. 27 (2): Pp. 251-265

Manda, S.O.M. (1998). "Unobserved Family and Community Effects on Infant Mortality in Malawi" *Genus* Vol 47: Pp 1841-1854.

McElroy, P.D., F.O. Ter Kuile, A.W. Hightower, W.A. Hawlley, P.A. Phillips-Howard, A.J. Oloo, A.A. Lal, and B.L. Nahlen. (2001): "All-cause mortality among young children in western Kenya". *American Journal of Tropical Medicine and Hygiene*. Vol. 64: Pp 18-27

McCullagh, P., and Nelder, J.(1989): *Generalised linear models* (2nd edition). London: Chapman and Hall.

Mosley, W, H., Chen, C. (1984) "An analytical Frame work for the study of child survival in developing countries" *Population and Development Review*, Vol. 10: Pp 25-45.

Mott, F. (1979). Infant Mortality in Kenya: Evidence from the Kenya Fertility Survey. Scientific Report 32. London: World Fertility Survey.

Nazrul M, Kamal H and Korban A (2009) "Factors influencing infant and child mortality: A case study of Rajshahi District, Bangladesh." *Journal of Human Ecology* Vol. 26: Pp 31–39.

Norman, P., Gregory, I., Dorling, D., & Baker, A. (2008) Geographical trends in infant mortality:England and Wales, 1970-2006. Office for National Statistics, Health Statistics Quarterly, winter; Vol 40: Pp 8-29.

Poffenberger, T (1981) "Child rearing and social structure in rural India: Toward a cross-cultural definition of child abuse and neglect." In J.E. Korbin (Ed.), *Child abuse and neglect: Cross-cultural perspectives*, pp. 71-95. Berkeley: University of California Press.

Reichman, N., Pagnini, D. (1997) "Maternal Age and Birth Outcomes: Data from New Jersey," *Family Planning Perspectives*, Vol. 29: Pp 268-272 & 295.

Scrimshaw, Susan C. M. (1978) "Infant mortality and behavior in the regulation of family size," Population and Development Review 4, Vol. 3: Pp383-403.

Simmons, George B., C. Smucker, S. Bernstein, and E. Jensen (1982) "Postneonatal mortality in rural India: Implications of an economic model," *Demography* 19, Vol. 3: Pp 371-389.

Ssewanyana, S and Stephen D. Younge (2005) "Infant Mortality in Uganda: Determinants, Trends, and the Millennium Development Goals" *SAGA Working Paper*.

Uganda Bureau of Statistics (UBOS) and ORC Macro (2001), Uganda Demographic and Health Survey 2000-2001. Calverton, Maryland, USA: UBOS and ORC Macro.

UBOS (2007). *Demographic and Health Survey*, 2006. Calverton, Maryland USA

Uganda Bureau of Statistics (UBOS) and Macro International Inc. (2007). *Uganda Demographic and Health Survey 2006*. Kampala, Uganda and Calverton, Maryland, USA: Uganda Bureau of Statistics and Macro International Inc

UNICEF (1999) *Duration of Breastfeeding and Diarrhoea; Breastfeeding Foundation for a Healthy Future*. New York.

UNICEF, State of the World's Children 2003 Report UNICEF, UNICEF House, 2 UN Plaza, New York, NY10017, USA Wadsworth Publishing Company USA

UNICEF, (2006) *Under five deaths by Cause report*.

UNICEF, (2006) *Facts on Children report*

UNICEF, WHO (2007), *The World Bank and UN Population Division, 'Levels and Trends of Child Mortality in 2006: Estimates developed by the Inter-agency Group for Child Mortality Estimation'*, New York.

UNICEF (2008). *Global child mortality rates continue to drop*, UNICEF reports.

United Nations Manual X, (1983) *Indirect Techniques for Demographic Estimation, Series A, Population Studies*, Vol No. 81 UNICEF, UNICEF House, 2 UN Plaza, New York, NY10017, USA Wadsworth Publishing Company USA

United Nations (1994), *The Health Rationale for Family Planning: Timing of Births and Child Survival*. Population Division, New York.

World Bank (2008), *The Growth Report: Strategies for Sustained Growth and Inclusive Development*, Washington D.C., Commission on Growth and Development, World Bank.

World Development Indicators 2006 report, Washington, DC.

WHO, UNFA and UNICEF (1999) *Reduction of maternal mortality*. Geneva:

World Health Organization. (2001). *Global Strategy for Infant and Young Child Feeding, The Optimal Duration of Exclusive Breastfeeding*, Geneva.

WHO (2005) *The World Health Report 2005 - Make Every Mother and Child Count*. World Health Organization.

Zere, E. and McIntyre, D. (2003), "Inequalities in under-five child malnutrition in South Africa", *International Journal for Equity in Health*, Vol. 2 (7).