Correlates of Infant and Child Mortality in Ethiopia 2005

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Abstract

Introduction
Risk of mortality prevails for children with shorter birth interval since their mothers are likely to have poor health.

Aim
The aim of the study is to determine the indirect estimation of infant and child mortality in Ethiopia.

Methods
The data sources for this study are the 2005 Ethiopian Demographic and Health Survey (EDHS).Cox's model is used to assess the association between childhood mortality, and selected socio-economic and demographic variables.

Results
The study findings show that childhood mortality declined by 35% during the last five years in Ethiopia, infant mortality declined by 21% and under-five mortality declined by 26%. Mortality rates are still high, however, birth interval, breastfeeding and birth order reflect strong mortality decline in many regions. Birth order, mother's age at childbirth, length of pervious and subsequent birth intervals, and mortality of an older sibling all have large effects on infant and child mortality. Among health interventions strongly associated with reduced childhood mortality.

Conclusion
It is thus recommended that further research is needed at regional level as well as national level investigation. As per the study, findings can be used as the basis for a number of policy recommendations.

Key words:
mortality, birth interval, breastfeeding, health intervention, health care

Introduction

Fertility behavior or biological factors (such as mother's age at childbirth, child birth order and previous and following birth intervals) affect infant mortality in developing countries (Hobcraft, McDonald and Rutstein 1985). One study found first born children and the children of higher birth order are known to experience higher mortality than children of birth order two to four (Bicego and Ahmed 1996); (Gribble, 1993). Another study found high risk of mortality prevails for children with shorter birth interval since their mothers are likely to have poor health (Pandey, Choe and Luther 1998; Rustein (2000). A number of studies have shown that prenatal care like the vaccination of pregnant mothers against tetanus can virtually eliminate deaths in early infancy UNICEF (2004). In the same token, proper medical attention at the time of delivery reduces the risk of death from birth injury. Post-natal care in the form of breastfeeding, immunization and appropriate medical treatment in case of illness can reduce the risk of infant and child mortality Ware (1984); Jain (1985); Assefa and Tesfaye (1997); Vinod and Retherford. (1997); Rutstein (2000); Sathiyasusuman (2000) and EDHS 2005.

All these health service utilization factors are known to be significantly correlated with infant and child mortality. According to the United Nations (2006); EDHS (2005) infant and under-five mortality in Ethiopia has continued to decline over the past 25 years with a more pronounced reduction in the last decade. Yet, overall infant and under five mortality rates remain very high: between 1995 and 2000. The Ministry of Health (2004) noticed that the data highlighted that almost one of every ten newborns (97 per 1000) did not survive to celebrate their first birthday, and one of every 6 children (166 per 1000) died before their fifth birthday. In 2006, for the first time since mortality data have been gathered, annual deaths among children under five dipped below 10 million. Nevertheless, the death of millions of children from preventable causes each year is unacceptable. Another study found a child born in developing country is over 13 times more likely to die within the first five years of life than a child born in an industrialized country. The USAID (2007) and United Nations (2008) noticed that Sub-Saharan Africa accounts for about half the deaths of children under five in the developing world. As shown, between 1990 and 2000, the rate of decrease of under-five mortality has only been less than 2 per 1000 live births per year.

The World Bank (1993) mentioned that Ethiopia should, therefore, reduce child mortality by 7.4 per 1000 live births per year between 2003 and 2015 in order to achieve the MDG goal in question. An another government agency Ministry of Health (2004) reported this task would be very challenging given past trends as well as major unmet needs for child survival in Ethiopia. Therefore, in-depth understanding of the levels, trends, differentials and determinants of childhood mortality is crucial in any attempt to attain the goal of reducing infant and child mortality level through proper and sustainable types of intervention. Thus this study aims to determine the indirect estimation of infant and childhood mortality in Ethiopia.

Data and Methodology

The data used for this study was the 2005 Ethiopian Demographic and Health Survey (EDHS). The 2005 EDHS sample was designed to provide estimates for the health and demographic variables. The EDHS 2005 questionnaire collected information on socioeconomic and demographic data, including age, religion, level of education, husband's occupation, and women's working status and current marital status. Reproductive issues such as age at marriage, number of pregnancies, deliveries and miscarriages; history of child death; number of living children, children ever born and sex of surviving children, woman's ideal preference regarding number of children.

Demographic Profile of the Study Sample

With a population of 78 million in 2007 (PRB, 2008), Ethiopia is the second most populous country in Sub-Saharan Africa next to Nigeria. The total fertility rate (TFR) is 5.2 children per woman. Demographic patterns reveal that women in the reproductive age group (15-49 years) constitute 23 % of the total population while 44 % of the population is less than 15 years old. This skewed age structure towards the young indicates the high potential for an accelerated population growth and heavy demand for all types of health services, including interventions for reproductive health. Access to health services remains limited. The health problems of mothers and children are related to fertility and childbirth. The maternal mortality rate of 673 per 100,000 live births and infant mortality rate of 77 per 1,000 live births are among the highest in the world. There is an increasing trend in the incidence of adolescent pregnancy, contributing to more than 30 % of the death toll arising from unsafe abortion (NOP, 2005). Only 28 % of women receive antenatal care and skilled personnel attend only 7 % of births. Postnatal care is extremely low in Ethiopia (CSA, 1995).

Cox's model was used to assess the association between childhood mortality, and selected socio-economic and demographic variables. Cox's regression builds a predictive model for time-to-event data. The model produces a survival function that predicts the probability that the event of interest has occurred at a given time and for given values of the predictor variables. The shape of the survival function and the regression coefficients for the predictors are estimated from observed subjects; the model can then be applied to new cases that have measurements for the predictor variables. Note that information from censored subjects, that is, those that do not experience the event of interest during the time of observation, contributes usefully to the estimation of the model (Cox, 1972).

In the present study, the dependent variable is childhood mortality and the main independent variables are the socio-economic and demographic variables. In order to account for regional differences, we created categorical variables that distinguished each region in Ethiopia. The analyses are both descriptive and multivariate. Based on the bivariate analysis, the model was fitted using the Cox's proportional hazard model.

This article describes Cox's proportional hazard model analysis of infant and different types of child mortality in Ethiopia. The main focus is not the absolute crude death rate, but rather the forces changing the crude death rate over a period of time. This research has tried to find out what the changes are and where Ethiopia stands concerning childhood mortality rates. However, there has been a substantial reduction in infant and child mortality rates in most developing countries in the recent past, child mortality remains a major public health issue in developing countries where it is estimated that over 10 million preventable child deaths occur annually.

Results

A total of 14,645 households were selected, of which 13,928 were occupied. The total number of

Table 1: Mortality differentials by demographic factors, EDHS 2005

Variables	No. of Births	Deaths Per 1000			
		NNM	PNNM	IMR	CMR
Sex of child		*		***	
Male	5027	42	40	79	25
Female	4834	28	15	56	28
Preceding Birth interval				***	***
< 2 years	1728	59	58	113	48
2-3 years	2885	26	33	58	20
3-4 Years	1740	22	26	47	27
4+ Years	1585	17	17	33	12
Duration of Breast Feeding		***		***	***
Never	352	506	127	568	64
< 6 Months	1578	84	153	214	84
6-12 Months	2178	0	38	38	52
More than a year	5569	0	0	0	15
Age at Birth		*		***	
< 20 years	1383	59	49	105	18
20-29 years	5203	32	31	61	28
30-39 years	2755	26	33	58	26
40-49 years	520	44	49	90	37
Size of Child				***	
Small	3058	40	41	79	24
Average	4022	28	27	54	28
Large	2723	34	35	68	24
Birth Order		**		**	*
1	1917	52	39	88	25
2-3	3073	28	31	58	20
4-6	3096	33	31	63	27
7+	1775	30	42	71	37
Multiplicity of Birth				***	
Single	9683	33	33	65	26
Multiple	178	124	109	219	56
Total	9861	35	35	68	26

*** = P< 0.001, ** = P<0.01, * = P<0.05, (***, **, * indicate level of significance at specified level).

households interviewed was 13,721 yielding a household response rate of 99 percent. The relationship between ages of mother at birth associated with childhood mortality is important determinants of childhood mortality.

The study found that age at birth of women less than 20 years, neonatal and infant mortality rates are quite high 59 and 105 respectively (see table 1) but EDHS 2005 shows neonatal mortality among mother's age at birth less than 20 were 57 but infant mortality 106 per 1000 (EDHS, 2005). These findings show more or less similar findings but child mortality in the same age group shows wonderful reduction only 18 per 1000. About 62 per 1000 this may be due to the mortality rates for the 10 years preceding the survey. However, the risk to children born by women over the age of forty express sharply increased (90 per 1000) infant mortality rates. Children from multiple births (twins, triplets, etc) experience much higher mortality than single births. It is a biological factor that plays a major role in the survival of infants.

Differentials in the various mortality rates by selected socio-economic factors are mainly focused on selected socio-economic characteristics in Ethiopia. Cleland and Ginnaken (1988) concluded mother's education is one of the strongest correlates of infant and child mortality because education provides women with decision making power, making them more aware of their children's welfare, and increasing their knowledge about childhood diseases and their ability to understand illness and provide timely treatment. Although one study found out that the effect of mother's education was substantially reduced when controlling for other variables (Bicego, George, Hill and Mahy, 1994). However, this study result shows that child mortality is 11 per 1000 children surviving with women's secondary and above education. As one would expect, mother's education has a stronger negative effect on neonatal and child mortality than on post neonatal mortality (which is strongly affected by biological factors).

A study conducted in Ethiopia identified significant relationship between maternal education and child mortality (Assefa and Mekonnen, 1997). The study findings show that neonatal, post neonatal and infant mortality is quite high in orthodox community when we compare with remaining groups. Other religion shows that child mortality is quite low 16 per 1000 (Mekonnen, 2001). The result in table 2 indicates relatively higher proportion of infant, neonatal and post neonatal mortality for mothers residing in Amhara region. Neonatal, post neonatal and infant mortality risk among women from Amhara region is 53, 43 and 93 percent higher respectively as compared with children born to mothers who were living in Addis. On the other hand, the current study reveals that childhood mortality is higher for women residing in Afar region as compared to women residing in other regions of the country (EDHS, 2005) and neonatal, post neonatal and infant mortality risk for infants born to mothers who were not in union are 26, 31 and 56 percent respectively higher than that of infants born to mothers in union. Similarly, children born to mothers who were not in union have 32 percent higher mortality risk than those children born to mothers who were in union.

Neonatal, post neonatal and infant mortality in the working category mothers having higher than non-working mothers 38, 42 and 78 respectively (see table 2). On the other hand, the current study reveals that childhood mortality is higher for non-working mothers (34, 32 and 65 per 1000) as measure to working mothers. In developing countries, childhood mortality is often thought to be higher in rural areas than urban areas because of differences in standards of living, health conditions and availability of or access to public health facilities and services.

The study reveals that children of mothers residing in rural settings have higher risk of dying during infancy, neonatal, post neonatal and childhood periods as compared to those residing in urban areas. With respect to wealth and mortality, children born to mothers in the middle wealth index are at higher risk of dying (neonatal 46, post neonatal 39, infant 67 and child 30) than children born to mothers in the lowest and highest wealth index during infancy, neonatal and childhood periods (World Bank, 2007b).

Discussion

In the previous part, the bivariate relationship between some background characteristics of women and children on the one hand and infant

Table 2: Mortality differentials by socio-economic factors, EDHS 2005

Variable	No. of Births	Deaths Per 1000			
		NNM	PNNM	IMR	CMR
Religion					
Orthodox	3897	37	35	71	24
Protestant	1776	34	35	68	25
Moslem	3847	33	35	66	30
Other	337	27	28	53	16
Educational Level				**	***
No education	7609	35	38	71	30
Primary	1548	39	25	63	13
Secondary &above	704	23	16	38	11
Region		**		**	*
Tigray	980	28	25	52	18
Afar	574	26	31	56	48
Amhara	1458	53	43	93	31
Oromiya	1938	37	32	68	27
Somali	663	33	38	69	26
Ben-Gumz	698	40	29	67	34
SNNP	1730	34	42	74	28
Gambela	515	23	36	58	12
Harari	514	21	26	47	22
Addis Abeba	380	24	24	47	7
Dire Dawa	411	27	35	61	20
Marital Status					*
Not in Union	641	44	39	81	37
Currently in Union	9220	34	34	67	25
Employment				*	
No	7590	34	32	65	27
Yes	2269	38	42	78	25
Type of place of residence				**	*
Urban	1,358	30	19	49	17
Rural	8,503	35	37	71	28
Wealth index		**		**	**
Poorest	2529	29.26	36.64	64.45	29.06
Poorer	1846	28.71	44.63	71.51	31.01
Middle	1837	46.27	39.28	83.29	32.25
Richer	1672	46.65	31.79	76.56	26.82
Richest	1977	26.30	20.95	46.54	12.74
Total	9861	35	35	68	26

*** = P< 0.001, ** = P<0.01, * = P<0.05, (***, **, * indicate level of significance at specified level).

and child mortality on the other has been assessed. In such type of analysis, there is always lack of estimating the net effect of a particular variable separately, and together as a group on the dependent variable; it is also difficult to know which factor is more important. In this analysis, we estimate the effect of each variable on neonatal, infant and child mortality using hazard models that include just one predictor variable. The objectives of the study can only be achieved by applying Cox's proportional hazard model is applied in order to examine the net effect of each independent variable on infant and childhood mortality by controlling the effects of other variables.

However, an analysis of 2005 shows a slight decline in the neonatal mortality levels in the country. This decline may be attributed to better quality of the EDHS 2005 data as compared to 2000 EDHS. The study findings clearly showed preceding birth interval 2-3 years is 2.7 times more neonatal mortality than those women who have birth interval less than 2 years which is statistically highly significant (see table 3). Another important determinant is duration of breastfeeding whose women gave less than six months duration of breastfeed 5.3 times higher than no breastfeeding. Those women gave multiplicity of birth which is 2.3 times higher neonatal mortality than single birth women. Therefore, preceding birth

Table 3: Proportional hazard model of relative effects of predictor variables on neonatal mortality, EDHS 2005

Selected Variables	B	Exp(B)	95.0% CI for Exp(B)	
			Lower	Upper
Sex of Child				
Male@				
Female	0.140	1.15	0.868	1.522
Multiplicity of Birth				
Single@				
Multiple	0.847	2.33***	1.418	3.836
Size of Child				
Small@				
Average	0.126	1.13	0.790	1.630
Large	0.179	1.19	0.846	1.690
Preceding Birth Interval				
< 2 years@				
2-3 years	0.989	2.69***	1.634	4.427
3-4 Years	0.376	1.45	0.883	2.401
4+ Years	0.168	1.18	0.685	2.044
Duration of Breast Feeding				
Never@				
< 6 Months	1.663	5.27***	3.957	7.037
Age at Birth				
< 20@				
20-29	0.510	1.67	0.970	2.860
30-39	0.009	1.01	0.694	1.467
40-49	0.014	1.01	0.598	1.719
Birth Order				
2@				
3-4	-0.037	0.96	0.632	1.469
5+	0.158	1.17	0.747	1.837

*** = P< 0.001, ** = P<0.01, * = P<0.05, (***, **, * indicate level of significance at specified level @

interval, duration of breastfeeding and multiplicity of birth became important neonatal mortality factors than other variables.

Reference category

Another relative effect of predictor variable is infant mortality. Infant mortality is clearly visible in women who are given less than two years preceding birth interval from first birth to second or second to third. Results show that 2-3 years interval has 3.5 times more infant mortality than 3-4 years and above 4 years birth interval as statistically highly significant (see table 4).

Preceding birth interval shows that women who gave 3-4 years between births are 1.8 times more infant mortality than reference category. Duration of breastfeeding for those women who have less than six months breastfeeding and those who have given 6-12 months breastfeeding shows 3.1 times

Table 4: Proportional hazard model of relative effects of predictor variables on infant mortality, EDHS 2005

Selected Variables	B	Exp(B)	95.0% CI for Exp(B) Lower	Upper
Place of Delivery				
Home@				
Health Institution	0.005	0..93	0.586	1.723
Preceding Birth Interval				
< 2 years@				
2-3 years	1.240	3.45***	2.455	4.863
3-4 Years	0.598	1.82***	1.295	2.554
4+ Years	0.398	1.49*	1.029	2.154
Duration of Breast Feeding				
Never@				
< 6 Months	2.949	3.08***	2.953	4.085
6-12 Months	1.954	2.05***	1.319	3.354
Sex of Child				
Male@				
Female	0.245	1.28**	1.054	1.547
Employment				
No@				
Yes	0.384	1.47*	1.181	1.826
Multiplicity of Birth				
Single@				
Multiple	1.059	2.88***	1.986	4.186
Age at Birth				
< 20@				
20-29	0.741	2.01***	1.453	3.028
30-39	-0.053	0.949	0.739	1.218
40-49	0.104	1.110	0.768	1.605
Birth Order				
2@				
3-4	0.155	1.168	0.872	1.563
5+	0.397	1.49**	1.086	2.039
Place of Residence				
Rural@				
Urban	0.228	1.26	0.773	2.039

*** = P< 0.001, ** = P<0.01, * = P<0.05, (***, **, * indicate level of significance at specified level

more infant mortality and highly significant probability <0.0.001 than reference category. Therefore, preceding birth interval and duration of feeding is an important determinant of the infant mortality.

Births with preceding birth interval of 2-3 years after the previous birth have also a higher risk (82 percent) of mortality compared to the reference category. Births with preceding birth interval of 3 to 4 years after the previous birth have also a higher risk (49 percent) of mortality compared to the reference category. In general being born within a very short birth interval (less than 2 years) is associated with a very high mortality risk. Generally, first born children fare worse than children of birth orders 2-3, after which mortality increases as birth order increases. The exception to this pattern occurs for child mortality. The interval from one birth to the next can also have a dramatic effect on the child's survival chances. For instance, the risk of dying for births of higher order (> 4) is nearly 50 percent higher than that of 2nd order births. This might be due to the fact that high-order births are born into families that already have a number of young children who compete for resources and parental care, and most of higher order births have mothers who are physically depleted. Such children are more likely than others to suffer from high mortality risks such as low birth weight.

Duration of breastfeeding showed a very large (>12 months) and statistically highly significant (P<0.001) effect 2.24 times higher on survival of infants (see table 5). For instance, infants who were less than 6 months breastfed had 4.9 times higher mortality risk than infants who were breastfed for 6-12 months or more months. Previous table 10 discussed about maternal age at birth the effect of maternal age at birth shows that infants born to mothers aged 20-39 years experience a lower mortality risk 2 times as compared to infants born to mothers aged less than 20 and = 40 years.

For instance, infant mortality for children of mothers less than 20 years at the time of birth of their child is two times higher than that for infants whose mothers were 20-29 years at the time they gave birth. Mortality risk among infants born to mothers 30-39 years is, however, almost the same as

Table 5: Proportional hazard model of relative effects of predictor variables on child mortality, EDHS 2005

			95.0% CI for Exp(B)	
Selected Variables	**B**	**Exp(B)**	**Lower**	**Upper**
Assistance of Delivery				
Traditional@				
Professional	-0.248	0.78	0.296	2.058
Preceding Birth Interval				
Less than 2 years@				
2-3 years	1.526	4.60***	2.441	8.677
3-4 Years	0.618	1.85	0.968	3.555
4+ Years	0.918	2.50***	1.289	4.863
Duration of Breast Feeding				
Never@				
< 6 Months	1.581	4.86***	2.210	10.697
6-12 Months	0.043	1.04	0.574	1.899
>12 Months	0.807	2.24***	1.546	3.250
Place of residence				
Rural@				
Urban	0.261	1.3	0.513	3.283
Marital Status				
Currently in Union@				
Not currently in Union	0.585	1.8	0.930	3.466
Educational Level				
No education@				
Primary	0.547	1.73	0.462	6.464
Secondary and Above	-0.325	0.72	0.173	3.020

*** P< 0.001, ** P<0.01, * P<0.05, (***, **, * indicate level of significance at specified level, @ Reference category infants born to mothers aged 20-29. Infant mortality for children of mothers 40-49 years at the time of birth of their child is 11 percent higher than that for infants whose mothers were 20-29 years at the time they gave birth.

The study findings also indicate that mortality risk for multiple births is more than twice higher than singletons. The higher risk among multiple births might be due to biological factors such as low birth weight and complications at delivery. Results indicate that mortality risk for children born less than 2 years after the previous birth is four times higher than that of the reference category (<2 years). Births with preceding birth interval of 3-4 years after the previous birth have also a higher risk (twice) of mortality compared to the reference category during childhood period. In general being born within a very short birth interval is associated with a very high mortality risk during childhood period. These findings are also consistent with other research and highlight the importance of birth spacing as a means of reducing child mortality. Children who were never breastfed and breastfed for short period of time have a higher mortality risk than infants who were breastfed longer period of time. For instance, children who were never breastfed had four times higher mortality risk than the reference category (Breastfed for more than a year).

Similarly, children who were breastfed for 6-12 months also have higher (twice) mortality risk than the reference category. Analysis of determinants in neonatal mortality overlaps with the infant mortality. As presented in the previous tables, most of the variables were explained in the determinants of childhood mortality. All aforementioned factors are identified throughout the nation.

Conclusions

The results of the study show that fertility behavior and the quality of maternal and child health care accessible to mothers and children correlate with childhood mortality. As estimated by the hazard model, the findings are consistent with the EDHS reports. Rural residence, mother's illiteracy, household's lack of access to a flush or pit toilet, and drinking water are associated with high infant and child mortality when each variable was examined separately at a time. In other words, all of these variables have strong effects on infant and child mortality. An examination of hazard models effects of socioeconomic characteristics on infant and child mortality leads to three general observations. First, all the variables have strong and statistically significant effects on mortality. Second, the effects of most socioeconomic characteristics are smallest during the neonatal period and largest during childhood. There are some exceptions, for example, religion and access to a flush or pit toilets have stronger effects on neonatal mortality than on post neonatal or child mortality. The third general observation is that effects of socioeconomic characteristics tend to be stronger in nation with high levels of mortality. This study also shows that the most important factors influencing infant and child mortality in Ethiopia are demographic in nature. The demographic factors identified in this study include birth order, maternal age at birth, multiplicity of birth, duration of breast feeding, birth interval, which are similar to those documented in many settings throughout Africa and other developing countries.

Policy Recommendations

As per the study, findings can be used as the basis for a number of policy recommendations. Encourage and promote women in the country to exclusively breastfeed their babies for longer period of time, as the results of this study indicated that lengthening birth interval could reduce both infant and childhood mortality. Availing contraceptive supplies and ensuring access to them will also help to lengthen the pace of child bearing and hence lower mortality risk of children in the country. Promotion of breastfeeding will have a great effect especially in areas where there is inadequate access to clean water supply and waste disposal facilities, as breastfeeding is found to be one of the most important variable that determine infant and childhood mortality. Efforts have to be made to improve family planning programs that may play a significant role in both fertility and mortality reduction, as higher order births are found to have a strong association with infant mortality and the presence of higher order birth is an indicator of high parity.

Effective education that discourage teenage child bearing and early marriage should be given to women, in order to curb the high mortality of children born to very young mothers in the region. Pulse polio immunization program is good for the health of children. Spacing births at least 2 years apart can reduce infant mortality. High risk fertility behavior should be avoided: infant and children have a greater probability of dying if they are born to mothers who are too young or too old, or if they are of high birth order. Multiple risk fertility behaviors (birth interval, birth order, breastfeeding and size of the child so on) those are associated with conceiving a child with high probability of dying. So, improving access to maternal and child health care should be given a key role in measuring Ethiopian children's well being and survival.

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