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Neonatal and post-neonatal mortality decline in Ethiopia: evidence from DHS 2005

Appunni SATHIYASUSUMAN[1]

Abstract

Neonatal mortality declined 17 per cent in Ethiopia between 2000 and 2005 Demographic and Health Survey, infant mortality declined 21 per cent and under-five mortality declined 26 per cent. However, mortality rates are still high but birth interval, breastfeeding and birth order reflect strong neonatal and post-neonatal mortality decline in many regions. Birth order, mother's age at childbirth, length of breastfeeding, subsequent birth intervals, and mortality of an older sibling all have large effects on neonatal and post neonatal mortality. Among health interventions strongly associated with reduced neonatal mortality.

Keywords: birth interval; birth order; neonatal; post-neonatal; infant; child mortality.

Introduction

This research article has tried to find out what the changes are and where Ethiopia stands concerning neonatal and post-neonatal mortality rates. Although 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 (World Health Organization (WHO), 2005). When argue about childhood mortality mother's 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, Rutstein, 1985, Bicego and Ahmed, 1996). First born children and the children of higher birth order are known to experience higher mortality than children of birth order two to four (Gribble, 1993).

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Hypothesize that birth order is higher 5 and above order births and for mothers who are younger than 18 years of age or are more than 35 years old at the time of giving birth and preceding birth interval is less than 24 months or 36 months. In addition, important factors health and education has been observed where behavioral factors directly or indirectly favor the health and survival of male children (Trussell, Miller, Pebley and Vaughan, 1992; Koenig, Philips, Campbell and Souza, 1990; Rajan and Mohanchandran, 1998; Hill and Upchurch, 1995). Maternal and child health are important factors associated with infant and child mortality (Ware, 1984).

A number of studies have shown that prenatal care like vaccination of pregnant mother against tetanus can virtually eliminate deaths in early infancy (UNICEF, 2004). In Ethiopia, 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 (United Nations, 2006; CSA, 2005). Yet, overall infant and under five mortality rates remain very high: between 1995 and 2000. The data show that almost one of every ten newborns (97 per 1000) did not survive to celebrate their first birthday, and one of every six children (166 per 1000) died before their fifth birthday (Ministry of Health, 2004). Given the slow pace of improvement in infant and child mortality to reach the child survival Millennium Development Goal (MDG) target by 2015, Ethiopia should have reduced under-five mortality at the rate of 5.2 per 1000 live births each year since the beginning of the 1990. 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.

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 (World Bank, 1993; Ministry of Health, 2004). 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 differentials and determinants of childhood mortality in particular neonatal and post-neonatal mortality research is crucial in any attempt to attain the goal of reducing infant and child mortality level through proper and sustainable types of intervention. In this article bring aim of the study is estimation of neonatal and post-neonatal mortality in Ethiopia. The main objective of the study, to decline in neonatal and post neonatal mortality in Ethiopia was compared with Ethiopian DHS 2005 data. In this article, updated mortality issues an approximate calculation from DHS 2005 for Ethiopia and described the relationship between neonatal and post-neonatal mortality and demographic characteristics in Ethiopia. To do this Brass (1968) and Trussell (1983) models were developed and replicable methodology to derive a single consistent time series of calculations for neonatal, post neonatal, infant, child and under-five mortality from the compiled data.

Data and Methodology

Data

The data sources for this study are the 2005 Ethiopian Demographic and Health Survey (EDHS). The EDHS is the second comprehensive survey conducted in Ethiopia as part of the worldwide Demographic and Health Surveys (DHS). The EDHS covered 9 regions and 2 administrative council areas and was conducted. This article brings on neonatal, post neonatal, infant and child mortality trends in Ethiopia over five years. Estimates are also used to assess the association between neonatal, post neonatal, infant and childhood mortality with selected demographic variables. Dependent variable is neonatal and post neonatal mortality and the main independent variables are the demographic variables. In order to account for regional differences created categorical variables that distinguished each region in Ethiopia. The analyses are both descriptive and multivariate. Based on the *bivariate* analysis, the models were fitted using the Trussell models of the neonatal and post neonatal mortality estimation and Brass model.

Indirect estimation for Model I

It has been observed that the accuracy of the estimates depend on rate of mortality decline, onset of childbearing and the age of children. The error is more when childbearing starts early and the age of children is higher. Further, it is observed that the decline in mortality affects the estimate more than the decline in fertility. In addition to this assumption, the quality of data also affects the estimates of neonatal and post neonatal mortality. In fact, the estimates based on data from 15-19 age groups (q_1) seem to be unreliable. Generally, q_2, q_3 and q_5 are taken as reliable estimates of mortality and q_1 is extrapolated from these values. While the same, indirect estimation of neonatal and post-neonatal mortality from data on children ever born and child surviving Trussell model is given below.

Mean age of mother at childbearing in the population. This variable is only used when data are tabulated by age of mother. If data are tabulated by duration of marriage, this value will not be used. An approximate estimate of mortality can be calculated from children ever born data.

Tabulations is indicates whether the data are tabulated by age group of mother, or by duration of her marriage. Children ever born are focused on the average number of children ever born to a woman. If "Tabulations" above is coded as "age of mother", the data are given by age groups (15-20, 20-25... 45-50); if "Tabulations" above is coded as "duration of marriage", the data are given by duration of marriage (0-5 years, 5-10 years... 30-35 years).

Children surviving which is the average number of children surviving per woman, either by her age group, or by duration of her marriage.

Indirect estimation for Model II

Another model is Brass (1968), a technique used to estimate neonatal and post neonatal mortality rate. It estimates mortality with an assumption that the risk of child death is a function of the age of the child only and does not depend on other factors such as mother's age or child's birth order (United Nations, 1983). However, the both mortality estimates obtained by the use of above method on live births to the women aged 15-19 are generally disregarded. It is partly because this assumption that it may not be in accordance with the reality and further the number of children born and dead to the women in this age group is usually small. In order to apply the procedure software package, MORTPAK was used and estimates were computed applying model life table. The estimating equations are as follows:

Average parity per women: $P_i = CEB_i / W_i$

Proportion of neonatal and post neonatal dead: $_{\text{Neonatal and post neonatal}} D_i = (CEB_i - CS_{i)}/CEB_i$

Probability of dying: $Q_i = K_i * D_{i\ \text{Neonatal and post neonatal}}$

Mean age at child bearing: $M = 2.25 * (P_3/P_2) + 23.95$

Where,

I = 1 for 15-19, 2 = 20-24, 3 = 25-29, age group …….respectively

CEB_i = Number of children ever born by women in the age group '$_i$'

W_i = Total number of women in the age group$_i$, irrespective of their marital status

$D_{i\ \text{Neonatal and post neonatal}}$ = Proportion of neonatal and post neonatal dead

K_i = Multiplier

$K_i = a_i + b_i * (P_1/P_2) + Ci * (P_3/P_2)$

The coefficient a_i, b_i and c_i are provided in United Nations Manual (1983) and vary between the four different families of model life table developed by Coale and Demeny system.

Mortality Scenario in Ethiopia

In Ethiopia, mortality rates should be interpreted with caution for several reasons. There may be differences in the completeness of death reporting related to the length of time before the survey. The accuracy of reports of age at death and of date of birth may deteriorate with time. Sampling variability of mortality rates tends to be high, especially for groups with relatively few births. Mortality rates are truncated as they go back in time because Ethiopian mothers currently age 50 or above who were bearing children during earlier periods were not included in the survey. This truncation affects mortality trends, in particular. For example, for the period 10-14 years before the survey, the rates do not include any births for women age 40-49 since these women were over age 50 at the time of the survey and were not eligible to be interviewed. Since these excluded births to older women were likely to be at a some what greater risk of dying than births to younger Ethiopian women, the mortality rates for the period may be slightly underestimated.

Estimates for more recent periods are less affected by truncation bias since fewer older women are excluded. The extent of this bias depends on the proportion of births omitted. Selection bias for infant and child mortality statistics as far back as fifteen years before the survey should be negligible. In this connection under reporting of births and deaths as well as misplacement of dates of birth and death are common in developing countries like Ethiopia where the great majority of the population particularly women, are illiterate and births as well as deaths are not registered. The decline in child mortality was more rapid than in neonatal or post-neonatal mortality, but still infant mortality it continues to be the highest in the country. Estimation of neonatal and post-neonatal mortality using indirect methods was presented here. In order to estimate these mortality indices, the Trussell variation of the Brass Indirect Technique (United Nations, 1983) was employed.

The Coale and Demeny model life tables were selected as the standard pattern of mortality, since the North Model is considered to be more suitable for a society that breastfeeds more than a year as is the case in the study area (United Nations, 1983). It is clearly noticed that women aged 20-34 (q_2, *and* q_3) have been proven to be more accurate women age group 20-24 child mortality 64 per 1000 and 25-29 reduced child mortality 54 per 1000 than the estimates of younger and older Ethiopian women (CSA, 1995). Neonatal mortality was declining 0.034 point last five years in the age group of 20-24 women.

Results

In case of mortality decline, it is argued that the estimate of infant and child mortality may not pertain to the survey year but to some time before the survey date. The methods are given to estimate the reference period for estimated infant and child mortality. In addition to that neonatal mortality (NNM), post-neonatal mortality (PNNM), infant (1q0), child (4q1) and under five (5q0) mortality rates are calculated by taking an average values of the five rates implied by NNM, PNNM, 1q(0), 4q(1) and 5q(0) from Table 1.

Table 1. Neonatal, post-neonatal, infant, child and under five Mortality rates with probabilities of dying before reaching exact age x with reference period estimated by Trussell model using 2005 DHS data of Ethiopia

Age of women	Neonatal mortality (NNM)	Post neonatal mortality (PNNM)	Infant (1q0)	Child (4q1)	Under five (5q0)	Reference period
15-19	0.117	0.117	0.117	0.09	0.196	2004.5
20-24	0.115	0.115	0.093	0.064	0.151	2003.4
25-29	0.109	0.096	0.082	0.054	0.132	2001.8
30-34	0.145	0.142	0.092	0.063	0.150	1999.9
35-39	0.194	0.197	0.102	0.073	0.167	1997.8
40-44	0.215	0.210	0.105	0.076	0.173	1995.5
45-49	0.255	0.210	0.114	0.087	0.191	1992.6

Source: Calculations based on DHS data. 2005

In addition, neonatal, post-neonatal, infant, child and under-five mortality rates for last five year period is presented here. Several macro level variables were used in various analyses. The most recent estimates EDHS 2005 show that overall childhood mortality has been declined tremendously. The decline rate for under-five mortality is coming down from 0-14 years preceding the survey. Particularly 5 to 9 years about 70 under-five mortality has declined. Even though, infant mortality rate also decline in the same period of survey around 50. But none of the cases were mentioned about neonatal or post-neonatal mortality rates. DHS 2005 shows neonatal and post-neonatal mortality rates are declining in the age group 20-24 and 25-29 which is 0.7 and 0.19 respectively. Because the Ethiopian government is undertaking a number of interventions aimed at reducing childhood diseases and mortality (MoH, 2006).

Ethiopian government has established the health sector development program and health policy with emphasis on disease prevention and control was formulated (USAID, 2007). Table 2, shows overall NNM rate was declined 17.1 and PNNM rate declined around 15. But still neonatal and post neonatal mortality rates have

not that much decline. This may be due to the fact that the pregnant women's antenatal care was quite low only 14 per cent and post natal care was extremely poor less than 10 per cent EDHS 2005. Majority of the deliveries conducted at home (about 90 per cent) with untrained birth assistance. Among health interventions, mother's tetanus immunization during pregnancy is strongly associated with neonatal mortality (Pandey, Choe and Luther, 1998). Based on the Trussell model the results reveal an overall decline in neonatal, post-neonatal, infant, child and under-five mortality rates between reference period 1992 and 2004.

Table 2. An average neonatal, post neonatal, infant, child and under-five mortality rates from Ethiopia DHS 2005 and 2000

Years preceding the survey	NNM	*Decline Rate*	PNNM	*Decline Rate*	(1q0)	*Decline Rate*	(4q1)	*Decline Rate*	(5q0)	*Decline Rate*
All	**41**	**+ 17.1**	**40**	**+ 14.8**	**80**	**+ 32.9**	**56**	**+ 28.5**	**132**	**+ 55.8**
0-4	39	+ 9.7	38	+ 10.3	77	+ 20	50	+ 26.7	123	+ 43.2
5-9	42	+ 26.3	42	+ 19.5	83	+ 46.8	63	+ 30.7	141	+ 70.4
10-14	46	+ 17.4	49	+ 20.7	95	+ 38	77	+ 19.3	165	+ 51.5

Source: DHS, 2005 and Decline rate is last five years DHS 2000

EDHS 2005 findings on neonatal and post neonatal mortality highlight the need for strategies that aim to change high risk fertility behavior and the need for policies and programs that will improve maternal and child health care. A major decline appears to have occurred in child mortality (35 per cent), with some what smaller declines in infant mortality (21 per cent). More concrete evidence has been presented in this regarding decline childhood mortality especially neonatal and post-neonatal mortality as a comparison estimates with Brass and Trussell models. As per the indirect estimate shows neonatal, post-neonatal mortality levels and trends vary by DHS 2005, and a noticeable decrease in specific age group of women. An average number of surviving children was found between age group of women and marital duration groups of women as positive effect except 40-50 years of Ethiopian women that showed negative effect.

Infant mortality rate has been reduced in the age group of 30-35 about 50 when we are compare with other age group. This may be due to the younger women in 30-39 an age at birth which is total number of births is less (2755 births) were influence infant mortality reduced. While the same 20-29 age group women produced more number of births which is 5203 births. Similarly, life expectancy at birth also increased quite well except 30-35, a remarkable increase in 10 years. Indirect estimate of infant and child mortality declined during the past 10 years. There is no doubt about despite the overall decline in childhood mortality, internationally mortality rates are quite high, however, one in every 12 children died before reaching age five. Clearly, child survival programs in Ethiopia need to

achieve further reductions in childhood mortality. We have also considered a number of covariates (predictor variables) of neonatal and post-neonatal mortality in this article. Mortality has been declining all over the world, partly as a result of advances in medical knowledge and technology as well as improvement in living conditions. The child's year of birth mainly captures this general trend in mortality. Unfortunately, preceding the survey 0-4 years shows neonatal mortality decline around 10 last five years.

Table 3. Estimation of neonatal, post-neonatal and child mortality in Ethiopia, DHS-2005

Age of Woman	CEB	CS	Brass Model	Trussell Model	NNM & PNNM	Probability of dying between ages 1 and 5	Life Expectancy at birth	Total Births
15 - 20	0.82	0.73	0.11	3.92	0.040	0.018	67.3	663
20 - 25	1.95	1.75	0.103	8.17	0.068	0.04	59.8	720
25 - 30	3.48	3.02	0.132	0.12	0.084	0.058	55.1	2396
30 - 35	4.96	4.44	0.105	0.11	0.068	0.041	59.3	2807
35 - 40	6.27	5.58	0.11	0.12	0.067	0.041	59.5	1500
40 - 45	6.98	5.62	0.195	0.21	0.104	0.076	50.8	1255
45 - 50	7.34	5.77	0.214	0.23	0.103	0.074	51.1	520

Source: Calculations based on EDHS data. 2005

As per the indirect estimates clearly shows that overall women age group 20-45 reduced infant and child mortality particularly 35-40 year age group shows 41 per 1000 (Brass model 11 per 1000 and Trussell model 12 per 1000) Table 3. It is well established that demographic factors of both the mother and child influence childhood mortality. In developing countries, low birth weight stems primarily from the mother's poor health and nutrition. Inadequate weight gain during pregnancy is particularly important since it accounts for a large proportion of fetal growth retardation. Birth spacing is generally believed to be associated with infant and child mortality. The proper spacing of births allows more time for childcare to make more maternal resources available for the care of the child, and also allows a healthier mother.

The findings show 79 per 1000 infant mortality is because the size of the baby is so small due to less birth interval. Several studies have found out that maternal nutrition and maternal depletion are key factors affecting mortality levels for births following a short birth interval (Miller, 1990; Gribble, 1993; Sullivan, Rutstein and Bicego, 1994; Bicego and Ahmed 1996). The study result shows less than 2 years previous birth interval have higher (neonatal 59 deaths per 1000), (post-neonatal 58 deaths per 1000) and infant mortality rates than higher birth interval (113 deaths per 1000) whereas, in the 2005, EDHS report says that 134

per 1000 deaths. This may be due to misreport. A study finding also show that short birth interval on mortality occurs during neonatal and post neonatal periods, and the weakest effect during the 1-4 years age period (Eberstein and Parker, 1984).

In general, male babies have higher mortality at all ages of childhood than female babies. Males have higher mortality rates during the first six months of life for genetic reasons, primarily due to higher vulnerability to infectious disease. A study showed higher under-five mortality among males than females in all of the 28 countries included in the study area (Sullivan, 1994). The data also indicates infant breastfeeding has an impact on the health of both the child and the mother. Many studies have shown the beneficial effects of breastfeeding on the nutritional status, morbidity and mortality of infants (Hobcraft, McDonald and Rutstein, 1985). Breastfeeding also has an indirect effect on the postpartum fecundity of mothers (Kennedy, 1990). The present study shows that neonatal and infant mortality is quite high due to mothers have never given breastfeeding to their child.

Duration of breastfeeding is one of the most important hypotheses have been tested it was showing a real manner. In association with related study findings shows, more frequent breastfeeding is associated with longer periods of post-partum amenorrhea, which in turn are related to longer birth intervals and lower fertility levels (Salway, 1998). The effects of breastfeeding on infant survival seem to be greater during the early months of life (Shah and Khanna, 1990). Duration of breastfeeding is one of the major reasons for childhood mortality in the study area. The birth order or rank of the child is closely associated with chances of survival (Sullivan, Rutstein and Bicego, 1994; Assefa and Mekonnen, 1997; Mahy, 2003). First births and high-order births (5Â births) carry higher than average mortality risk compared with other births. The high mortality of first and higher order births may be related to the age of the mother at the birth of the child, which is termed as high risk births for very young and older mothers. This association is likely to reflect not only the effect of birth order but also the effect of the age of mother at childbirth. In the study, results show child mortality rate declines slightly from the first birth order to the second birth order and increases steadily with birth order. As indicated above, the relationship between ages of mother at birth associated with childhood mortality is important determinants of childhood mortality. When women give birth at young age, they are at increased risk of complications and the child is at an increased risk of low birth weight and pre maturity. When women give birth at older age, they are more likely to have pregnancy complications, and the baby is more likely to have birth defects, which increases the risk of dying in early childhood.

Table 4. Survivors and neonatal, post-neonatal, infant, child and under five mortality differentials by demographic characteristics, DHS 2005

Characteristics	Total No. of Births	Survivors age < month	Survivors at age one year	NNM	PNNM	(1q0)	(4q0)	(5q0)
Total	**9861**	**9412**	**7267**	**35**	**35**	**68**	**26**	**120**
Size of Child								
Small	3058	2920	2290	40	41	79	24	123
Average	4022	3857	3004	28	27	54	28	112
Large	2723	2591	1942	34	35	68	24	98
Preceding Birth interval						***	***	
< 2 years	1728	1618	1314	59	58	113	48	131
2-3 years	2885	2784	2209	26	33	58	20	126
3-4 Years	1740	1672	1241	22	26	47	27	125
4+ Years	1585	1537	1124	17	17	33	12	99
Sex of child				*		***		
Male	5027	4770	3638	42	40	79	25	111
Female	4834	4642	3629	28	15	56	28	108
Duration of Breast Feeding				***		***	***	***
Never	352	173	140	506	127	568	64	147
< 6 Months	1578	1340	215	84	153	214	84	152
6-12 Months	2178	2178	1214	0	38	38	52	135
> year	5569	5569	5569	0	0	0	15	128
Birth Order				**		**	*	***
1	1917	1795	1377	52	39	88	25	100
2-3	3073	2959	2285	28	31	58	20	110
4-6	3096	2955	2289	33	31	63	27	98
7+	1775	1703	1316	30	42	71	37	116
Age at Birth				*		***		***
< 20 years	1383	1292	1034	59	49	105	18	133
20-29 years	5203	4987	3851	32	31	61	28	122
30-39 years	2755	2641	2026	26	33	58	26	129
40-49 years	520	492	356	44	49	90	37	125
Multiplicity of Birth						***		***
Single	9683	9256	7160	33	33	65	26	97
Multiple	178	156	107	124	109	219	56	125

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

The study found out that neonatal (59 deaths per 1000), post-neonatal (58 deaths per 1000) and infant mortality rates are quite high 59 and 105 respectively (see table 4). As per the EDHS 2005 report shows neonatal mortality among mother's age at birth less than 20 were 57 but infant mortality 106 per 1000. These findings show more or less similar findings but child mortality in the same age group shows marvelous reduction only 18 per 1000. EDHS report says 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. The study findings shows that 1.8 per cent of the births become multiple births. A study based on DHS data show that in Eritrea, children of multiple births are five times more likely to die in the first year of life than children of singleton births (Mahy, 2003).

In developing countries, neonatal, post-neonatal, infant and 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. Analysis show 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, 2007). Children born to mothers from the lowest wealth index are relatively in the highest risk of dying during post neonatal periods. Environmental health refers to characteristics of environmental conditions, which affect the quality of life. Environmental health is concerned with those forms of life, conditions in the surroundings of man that may exert an influence on human health and well-being. Man not only interacts with his environment but is shown to be a vital factor of his own environment (Mishra and Retherford, 1997).

Hazard model analysis

The data clearly illustrate that women delivered at a medical facility are likely to experience lower mortality risk than delivered at home because such facilities usually provide a sanitary environment, proper birth assistance and vaccination and so on. But in developing countries like Ethiopia most births takes place at home (90 per cent) and therefore, the risk of mortality is higher. The result in table 5 demonstrates that neonatal, post neonatal, infant and child mortality is lower among mothers who receive assistance from health professionals as compared to mothers who receive assistance from traditional birth attendant.

Table 5. Estimation of relative effects of predictor variables on neonatal mortality, DHS 2005

Selected Variables	B	Exp(B)	95.0% CI for Exp(B)	
			Lower	Upper
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				
Less than 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[@]				
Less than 6 Months	1.663	5.27***	3.957	7.037
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
Age at Birth				
Less than 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
Wealth Index				
Poorest[@]				
Poorer	-0.549	0.579	0.363	0.923
Middle	-0.699	0.497	0.304	0.814
Richer	-0.132	0.877	0.549	1.400
Richest	0.076	1.079	0.665	1.753

Source: Calculations based on EDHS data. 2005

Infant mortality rate was quite high (75 per 1000) where the source of drinking water was unprotected. Even though infant mortality was high those who are drinking protected water shows 69 per 1000. Another important determinant variable is women's d*ecision making on Health Care.* Women decision to have health services on themselves are taken as an indicator of empowerment. Unfortunately the relationship between neonatal, post neonatal, infant and child mortality with women health decision shows no consistent relationship. For example, childhood mortality rates depending on whether the mother received any antenatal or delivery care. The data clearly illustrates that mothers who receive either antenatal care or only one type of care suffer higher neonatal and infant mortality than mothers who receive both antenatal and delivery care. Apart from that women's decision making power is associated with child survival.

Children who are perceived by their mothers to be smaller than average at birth experience much higher mortality risks than children perceived to be of average size or larger. Mortality among children perceived to be very small is markedly higher. However, mothers in Ethiopian DHS survey were asked whether their child was very large, larger than average, average or small at birth since this has been found to be a good proxy for the child's weight (EDHS, 2005). Child with average weight at birth seems to have higher mortality risk during early childhood period as compared to their small and large counterparts. Birth size as reported by the mother; rates are for the last five year period preceding the survey.

The length of birth interval between births has a significant influence on a child's chances of survival. Short birth intervals are associated with high rates of infant and child mortality. The risk of dying during infancy, neonatal and post neonatal period for children born less than two years after a previous birth is more than three times that of children born four or more years after a previous birth. Similarly mortality among children born less than two years after a previous birth is four times the level among children born four or more years after a previous birth. These findings are also consistent with other research and highlight the importance of birth spacing as a means of reducing neonatal mortality.

Although the length of the previous birth interval is likely to affect mortality risks directly, a substantial portion of the association between birth intervals and mortality risks may reflect the effect of factors that are correlated with birth intervals. For example, shorter birth intervals are likely to occur in large families, and large families tend to come from lower socio-economic groups and are more likely than other families to live in rural areas where medical facilities and other survival enhancing resources are less readily available. Nevertheless, multivariate analysis of birth interval effects and child survival commonly find an association between short birth intervals less than 24 months and increased mortality even after controlling for other demographic and socio-economic characteristics (Retherford, Robert, Choe, Thapa and Bhakta, 1989).

Various studies have indicated that breastfed infants experience a lower mortality risk than artificially fed infants (Ebrstein and Parker, 1984). The effect of breast-feeding is pronounced during infancy and childhood period. According to the study findings those infants who were never breastfed had 8 times higher child mortality risk than those breastfed for less than 6 months during neonatal period; and had 3 times higher mortality risk than those breastfed for less than 12 months during post neonatal period. Infants who were never breastfed had 15 times higher mortality risk than those who breastfed for 12 months. Moreover, children who were never breastfed had 4 times higher mortality risk during childhood period than those who breastfed for more than a year.

As expected, infants born to mothers who are below age 20 had lower chances of surviving because of low birth weight, which is probably an important factor contributing to their higher neonatal mortality rate. Similarly children born to mothers above 40 are at a relatively high risk of experiencing congenital problems. Infant mortality is higher for infants born to mothers above age 40. Similar relationship is observed in neonatal and post neonatal mortality. Children of women in the age group 40-49 have higher childhood mortality than those of younger (<20 years) and older (21-40 years) age groups. Generally, mortality is high for first born children as well as births of very high orders, and is low for intermediate birth orders. In table 5 indicates that the expected high neonatal, post neonatal, infant and child mortality for first and higher (5Â) order births is evident.

The possible explanation for greater risk to first order and higher order births is that first order births are more likely to have a difficult birth process than later births, thus increasing the risk of neonatal mortality. Moreover, first-born children are likely to be raised by parents with limited skills and experience, possibly increasing the risk of infant and child mortality. Births of very high order may have mothers who are physically depleted at the time of conception and throughout pregnancy and the births may have low birth weight. Household wealth is strongly associated with childhood mortality risk. Children born to the wealthiest households have mortality risks lower than those born into the poorest. Similar to education, the way in which household income and wealth affect child mortality is complex. Income is often used as a proxy for children's consumption of goods and services such as shelter, nutrition, and adult supervision that may affect their health. It should be noted that, due to difficulties in monetary conversion, household wealth is often used as a proxy for income and it is primarily measured from a set of objects owned by a family, such as durable goods (United Nations, 1985). Childhood mortality is consistently higher in non-urban areas. This is also true of African rural residents compared to their urban counterparts.

Discussion

Bi-variate 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 addition, estimate the effect of each variable on neonatal, infant and child mortality using hazard models that include just one predictor vari-able. However, the estimates of 2005 show 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. 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 interval, duration of breastfeeding and multiplicity of birth became important neonatal mortality factors than other variables.

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 (Breast-fed 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. Most of the variables were explained in the determinants of childhood mortality. All aforementioned factors are identified throughout the nation. It is important to discuss about neonatal mortality by regions level.

Conclusions

The results of the DHS 2005 show that fertility behavior and the quality of maternal and child health care accessible to mothers and children correlate with childhood mortality. An examination of Brass and Trussell models effects of demographic characteristics on neonatal, post-neonatal, infant and child mortality leads to general observations. All the variables have strong and statistically significant effects on mortality. The effects of demographic characteristics are smallest during the neonatal period and largest during childhood. There are some exceptions. For example, birth interval 2-3 years and breast feeding more than six months have stronger effects on neonatal, post-neonatal mortality than child mortality. This study also shows that the most important factors influencing neonatal, infant and child mortality in Ethiopia are demographic in nature. The demographic factors identified such as 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.

Therefore, further research is very urgent for 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. 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 neonatal, post neonatal, 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 neonatal, 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 neonatal and post-neonatal 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 3 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. Levels and trends in childhood mortality in gauging the major impact of maternal and child health programs that seek to improve the health of infant and children.

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