Levels, Trends and Determinants of Under-Five Mortality in Amhara Region, Ethiopia Using EDHS (2000 - 2011)

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Abstract: Children are the human resource banks of every nation. Above all, the first five years of life are the most crucial to the physical and intellectual development of children and can determine their potential to learn and thrive for a life time. Under-five mortality is a key indicator of social and economic development and has received attention as a part of United Nations Millennium Development Goals. This is due to more than any other age group of a population, children survival depends on the socio-economic condition. In Amhara region under-five mortality remains one of the public health problems. Although the region has made remarkable progress in reducing under-five mortality over decades it still remains high. The objective of this study is thus to assess the levels, trends and determinants of under-five mortality in Amhara Regional State, Ethiopia. The source of data comes from the three nationally representative Ethiopian Demographic and Health Surveys conducted in 2000, 2005 and 2011. A total of 8,479 children included in this study. Of these children 3,202, 2,621 and 2,656 were from 2000, 2005 and 2011 surveys, respectively. The analysis tools used include both descriptive and inferential statistics. The finding of the descriptive statistics indicates that under-five mortality was declining over the period 2000 to 2011. Moreover, the result of multivariable analysis revealed that the hazards of under-five mortality were found to be significant for male, children born from illiterate and primary school mothers, children born outside marital union, mothers who do not use contraceptive and household without access to improved water. Thus, the result suggests that support system geared towards improving access and choices to women secondary educational training, integrating family planning with child survival programmes and improving sources of drinking water can reduce the existing high under-five mortality rate in the region.

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1. Introduction

The first five years of life are the most crucial to the physical and intellectual development of children with strong reflections on the future of a country (Gulati, 2010 and Siddiqi et al., 2011). Under-5 mortality (U_5M) has become one of the most important policy agenda in particular at global level recognized under United Nations Millennium Development Goals (UN MDGs). It is also one of the key indicators of social and economic development and in particular child survival interventions (McGuire, 2006). According to United Nations Children's Fund (2009) one of the target of UN MDGs is to reduce U_5M by two thirds between 1990 (93 deaths of every 1,000 live births) and 2015 (31 deaths of every 1,000 live births) in developing countries. This is pertinent as the progress and future of a country depends on wellbeing of children reflected in access to basic health care, nutritious food and a protective environment.

Evidence at global level indicates that the number of children dying under the age of five dropped remarkably from 12 million in 1990 to an estimated 6.6 million in 2012 (UNICEF, 2013). However, despite the millions of lives saved, almost 18,000 children die every day before the age of five (WHO, 2012) and more than half of these child deaths are due to conditions that could have been prevented.

Sub-Saharan Africa is the most affected accounting for more than one-third of deaths of children under age of five. Although decline in the rate of U_5M worldwide it is one of the main public health problems in the region where one in eight children dies before the age of five years, more than 20 times the average of industrialized countries (1 in 167 live births) (Ojikutu, R.K., 2008).

Ethiopia, one of the poorest and second most populous countries in sub-Saharan Africa faces high U_5M rates. It is among the six countries that account for 50% of children U_5M globally, with 194,000 deaths every year (UNICEF, 2012) where one in every 11 children dies before celebrating their fifth birthday.

More than one third of the deaths are largely due to communicable diseases that could have been easily prevented and treated using low-technology interventions (WHO, 2012).

Though U_5M is one of the public health problem in Ethiopia, evidence revealed that U_5M rate has declined by 57 percent from the 1990 figure of 204/1,000 live births to 88/1,000 live births in 2011 (CSA and ORC Macro, 2012). According to the 2011 EDHS, the country's U_5M was 88 deaths per 1,000 live births while the disaggregated data revealed a significantly higher U_5M in rural area (114 deaths per 1,000 live births) compared with urban area (83 deaths per 1,000 live births) and still variations among regional governments from as low as 53 deaths per 1,000 live births in Addis Ababa to as high as 169 deaths per 1,000 live births in Benishangul-Gumuz regional government (CSA and ORC Macro, 2012).

Reducing U_5M is a focus of governments all over the world. The Ethiopian government has prioritized MDG number 4 as one of its national development targets. More recently, the Growth and Transformation Plan (GTP) (2010/11-2014/15) has outlined the strategic measures that can significantly contribute to reduce U_5M. These include improving the literacy of mothers, improving the quality and coverage of basic health services, maternal and child health, the supply of family planning, access to water supply and household sanitation (MoFED, 2010).

The study area, the Amhara National Regional State (ANRS), is the second most populous region in Ethiopia. Children under the age of five years constitute about 16 percent of the total population of the region (CSA, 2007). The region has made remarkable progress over decades with improved health and education. Despite these improvements, U_5M remains one of the main problems in the region due to the high prevalence of malnutrition and childhood diseases such as acute respiratory infections, measles, diarrhea, cough, fever and so on. Recent figures show that U_5M rate in the region have been substantially reduced (CSA and ORC Macro, 2012). However, under-served zones and weredas still have high U_5M than their better off due to socio-economic, bio-demographic and environmental factors.

The paper aims to assess the levels and trends of U_5M and identifies the most significant determinant in ANRS using EDHS 2000-2011. Thus, the government gives more attention on those key determinants and develops and implements appropriate intervention of child health strategy for further reduction of U_5M in the region.

2. Data and Methods

The data source for this analysis is the Ethiopian DHSs undertaken during the years 2000, 2005 and 2011. The data for Amhara National Regional State was extracted from the 2000, 2005 and 2011 DHS data sets.

The sample was selected using a stratified, two stage cluster design. Enumeration areas were the sampling units for the first stage and households comprised the second stage of sampling. A complete listing of households was carried out in each of the selected enumeration areas and a representative sample of households was selected. All women of reproductive age found in the selected households were interviewed. The tool used to collect information from these women had background characteristics of women, birth history of these women, child mortality, knowledge and use of contraceptive method at the time of the interview (CSA and ORC Macro, 2000, 2005 and 2012).

The study presented here, based on the conceptual framework of child survival for developing countries proposed by Mosley and Chen (1984) for the analysis of the determinant of U_5M. The independent variables considered in this study are socio-economic, bio-demographic and environmental factors such as sex of child, perceived size of child at birth, birth order, birth interval, current marital status of women, mother's educational status, age of mother's at child birth, contraceptive use, place of residence and source drinking water.

Data management and analysis was carried out using STATA 13. The analytical tools used in this study include both descriptive and inferential statistics. Descriptive statistics include frequencies, percentages and tables used to analyze and present the socio-economic characteristics of the study population. At the multivariate analysis, Cox Proportional Hazards Model was employed to identify the determinants of U_5M. Hence, a survival analysis, standard semi-parameteric analytical method, is used to estimate the risk of dying (expressed in hazard ratio) before the age of five years. A positive regression coefficient (i.e., $HR > 1$) means the hazard is higher, i.e., increased the risk of U_5M. Conversely, a negative coefficient ($HR < 1$) implies the hazard is lower, i.e., a decreased risk of U_5M (Cox, D.R., 1972).

3. Results and Discussion

3.1 Results

3.1.1 Levels and Trends of Under-five Mortality Rate in Amhara National Regional State

Table 1 presents the levels and trends of U_5M rates in ANRS for the period of 2000, 2005 and 2011. Accordingly, the levels of U_5M in ANRS were 183, 154, and 108 deaths per 1,000 live births. The trends

show an encouraging progress with U_5M being reduced from 183 per 1,000 live births in 2000 to about 108 per 1,000 live births in 2011; this is equivalent to the reduction rate of 41 percent for the period of 11 years (four per year). Noticeable decline in U_5M has shown between 2005 and 2011 (which is 30 percent reduction or six percent per year).

Table 1 - Levels and trends of U5M in ANRS, 2000-2011

Region	Survey Year			% Change in U5M(2000-2011)	% Change in U5Mper year
	2000	2005	2011		
ANRS	183	154	108	-41	3.7

Source: *Calculated from 2000, 2005 and 2011 EDHS data.*

Thus, U_5M rate in ANRS exhibited a declining trend. The general reduction in U_5M attributed to wider coverage of basic health services, improving maternal and child health, involvement of health extension workers and other health related programmes by the Amhara regional government. However, with about one in nine live births do not celebrate their fifth birth day in the region. This is the highest even by sub-Saharan Africa standard. Most of these children die from preventable diseases. With the region being committed to achieve the MDGs on U_5M, ANRS have to reduce U_5M at least by 9 deaths per 1,000 live births per year between 2000 and 2015. This is challenging task given the past track record as well as major unmet needs for child survival in the region. Thus, in-depth understanding of the determinants of U_5M in ANRS is crucial in any attempt to attain the goal of reducing U_5M level through proper and sustainable intervention strategies.

3.1.2 Results of Descriptive Statistics

Table 2 revealed percent distributions of children dead and alive by bio-demographic, socio-economic and environmental characteristics in Amhara National Regional State from 2000-2011. In this study, a total of 8,479 children were included. Of these children 3,202, 2,621 and 2,656 from the 2000, 2005 and 2011 surveys, respectively. The result depicts that 13, 12 and seven percent children died before the age of five in 2000, 2005 and 2011, respectively. Evidence shows both the level and trend of U_5M differs when sex of child is considered. The result revealed that there were more male child deaths as opposed to female child deaths across all survey times and also the pace at which the rate of U_5M declines for females is higher than the males.

Variation in U_5M is also exhibited with birth order. U_5M is higher for the first birth order and steadily declines the consecutive birth orders and then again starts increasing. The result shows higher U_5M occurred in the lower birth order children for 2000 (17 percent) and 2005 (16 percent) data sets while lower (nine percent) for the 2011 data set. The length of birth interval is one of bio-demographic factors that influence U_5M. As can be seen (Table 2) highest rate of U_5M occurred to those preceding birth interval less than 24 months (21 percent) and (20.5 percent) for the 2000 and 2005 survey years, respectively however U_5M were very low for the 2011 data set. In contrast, the result also depicts lower U_5M for children whose preceding birth interval is 4 and above for the three data sets.

Child's size at birth is as well an important factor of its survival. The result however illustrated that large size children at birth experienced more U_5M for the three surveys.

Mother's education level can affect child survival. In view of this, the result of the three data sets revealed that highest U_5M were exhibited with mothers who had primary education and illiterate as opposed to relatively lowest U_5M observed among children whose mothers with educational level of secondary and above.

Besides, the age of mother at the time birth of the baby is also an important factor for the variation of U_5M in ANRS. The result demonstrated that highest U_5M were found among mothers whose age at birth was less than 18 years and above 35 years.

As far as contraceptive use is concerned, the result of the three data sets revealed children of mothers who did not use contraceptive had higher U_5M than mother who have used contraceptive. In addition, differential of U_5M observed with marital status of women. The result illustrated that children living with mothers not in union had higher U_5M for the 2000 (11 percent) and 2005 (11 percent) survey year as compared with women in union (seven percent) for the 2011 survey year.

The levels and trends of U_5M also vary with the place of residence of mother and child. The urban areas usually have better infrastructure for health services compared to rural areas. In terms of absolute number, the number of deaths in rural areas is far greater than number of deaths in urban area due to socio-economic, bio-demographic and environmental differentials. However, the result of the first survey shows higher U_5M in urban than rural areas. Alternatively, U_5M was smaller (five percent) for children born in urban area for the 2005 and 2011 survey year as oppose to those children born in rural area (12 percent).

In addition, source of drinking water has a profound implication for the health outcomes of both mother and child. The result indicated that U_5M was higher in households with non-improved sources of drinking water compared to households with improved sources of drinking water for the three surveys.

Table 2. Percent distributions of children dead and alive by bio-demographic, socio-economic and environmental characteristics, ANRS 2000 – 2011

Variables and Categories	Survey Year							
	2000		2005		2011		% Change	
	Survival status		Survival status		Survival status		2000-2011	
	Dead	Alive	Dead	Alive	Dead	Alive	Dead	Alive
Sex of Child Male	14.3	85.7	12.5	87.5	8.8	91.2	-38.5	6.4
Female	10.9	89.2	10.9	89.2	4.6	95.4	-57.8	7.0
Birth Order First birth	17.3	82.7	15.8	84.0	8.6	91.6	-50.3	10.8
2-3	11.4	88.6	9.6	90.3	8.1	91.9	-28.9	3.7
4-6	11.7	88.2	11.6	88.4	4.8	95.2	-59.0	7.9
7+	11.7	88.3	11.1	88.7	5.4	94.6	-53.8	7.1
Birth Interval (year) First birth	17.9	82.1	15.8	84.0	8.6	91.6	-52.0	11.6
<2	21.0	79.0	20.5	79.5	6.3	93.4	-70.0	18.2
2	12.6	87.5	10.4	89.6	8.8	91.2	-30.2	4.2
3	8.0	92.0	10.7	89.3	5.4	94.6	-32.5	2.8
4	8.7	91.3	8.0	92.4	4.8	95.2	-44.8	4.3
5+	7.9	92.1	3.2	96.8	4.7	95.3	-40.5	3.5
Size of child at Birth Large	21.0	79.2	16.7	83.4	12.4	87.6	-41.0	10.6
Average	11.8	88.2	10.5	89.5	4.5	95.6	-61.9	8.4
Small	8.9	91.1	9.4	90.6	5.4	94.6	-39.3	3.8
Women Education Illiterate	12.5	87.5	12.0	88.0	7.0	93.0	-44.0	6.3
Primary	15.7	84.3	12.4	87.6	5.9	94.1	-62.4	11.6
Secondary+	7.8	92.2	2.5	97.5	2.9	97.1	-62.8	5.3
Women age at birth <18	17.9	82.1	20.9	78.7	13.3	86.7	-25.7	5.6
18-34	11.8	88.2	10.8	89.2	6.7	93.3	-43.2	5.8
35+	13.4	86.6	11.5	88.5	4.0	95.8	-70.1	10.6
Marital Status of the mother Not Union	24.8	75.2	19.6	80.8	6.0	93.6	-75.8	24.5
Union	11.0	89.0	11.0	89.0	6.8	93.2	-38.2	4.7
Contraceptive use of the mother Not Use	12.7	87.4	12.0	87.9	7.5	92.5	-40.9	5.8
Use	12.5	87.5	9.9	90.1	4.9	95.1	-60.8	8.7
Place of Residence Urban	15.7	84.3	5.1	94.9	5.7	94.6	-63.7	12.2
Rural	12.4	87.6	12.2	87.8	6.9	93.1	-44.4	6.3
Source of drinking water Unimproved	12.9	87.1	11.9	88.1	7.8	92.2	-39.5	5.9
Improved	9.8	90.2	11.4	88.6	3.3	96.7	-66.3	7.2
Total	12.6	87.4	11.8	88.2	6.7	93.3	-46.8	6.8
Number (weighted)	3,202		2,621		2,656			

Source: Calculated from 2000, 2005 and 2011 EDHS data.

Table – 3. Determinants of U_5M using the Cox Proportional Hazard Regression Model, ANRS 2000-2011						
			Survey Year			
Variables and	2000		2005		2011	
Categories	HR	95% CI	HR	95% CI	HR	95% CI
Sex of Child						
Male (ref.)	1.00		1.00		1.00	
Female	0.79**	(0.64 – 0.97)	0.86	(0.68 - 1.09)	0.54***	0.39 - 0.74
Birth Interval (Year)						
First births (ref.)	1.00		1.00		1.00	
<2	1.15	(0.82 -1.61)	1.41*	(0.95 - 2.07)	1.36	(0.73 - 2.53)
2	0.66**	(0.48 - 0.91)	0.66**	(0.46 - 0.97)	1.11	(0.68 - 1.80)
3	0.36***	(0.25 - 0.52)	0.69*	(0.47 - 1.03)	0.70	(0.40 - 1.21)
4	0.43***	(0.27 - 0.67)	0.57**	(0.34 - 0.96)	0.65	(0.34 - 1.24)
5+	0.39***	(0.24 - 0.65)	0.14***	(0.06 - 0.33)	0.78	(0.42 - 1.45)
Perceived Child Size at						
birth, Large (ref.)	1.00		1.00		1.00	
Average	0.55***	(0.43 - 0.69)	0.63***	(0.48 - 0.83)	0.42***	(0.29 - 0.61)
Small	0.40***	(0.31 - 0.52)	0.51***	(0.38 - 0.69)	0.46***	(0.32 - 0.66)
Maternal Education						
Illiterate (ref.)	1.00		1.00		1.00	
Primary	1.31*	(0.95 - 1.80)	1.00	(0.71 - 1.41)	0.82	(0.53 - 1.28)
Secondary+	0.34***	(0.15 - 0.79)	0.25*	(0.06 - 1.05)	0.62	(0.15 - 2.56)
Age of mother at child						
birth, <18	0.91	(0.63 - 1.31)	1.50**	(1.02 - 2.23)	2.00**	(1.17 - 3.42)
18-34 (ref.)	1.00		1.00		1.00	
35+	1.43***	(1.09 - 1.88)	1.16	(0.84 - 1.61)	0.65	(0.39 - 1.10)
Marital status of the						
mother						
Not in union (ref.)	1.00		1.00		1.00	
In union	0.39***	(0.30 - 0.50)	0.60***	(0.44 - 0.84)	1.41	(0.79 - 2.52)
Contraceptive use of the						
mother						
Not use (ref.)	1.00		1.00		1.00	
Use	0.78	(0.51 - 1.19)	0.87	(0.61 - 1.25)	0.65**	(0.45 - 0.95)
Place of Residence						
Urban (ref.)	1.00		1.00		1.00	
Rural	0.43***	(0.26 - 0.71)	2.47**	(1.07 - 5.67)	1.47	(1.03 - 2.08)
Source of Drinking						
water						
Unimproved	2.57***	(1.50 - 4.42)	2.01***	(1.18–3.42)	2.14***	(1.28 - 3.59)
Improved (ref.)	1.00		1.00		1.00	
Twin						
No (ref.)	1.00		1.00		1.00	
Yes	9.02***	(6.25 - 13.01)	5.07***	(2.77 - 9.30)	8.94***	(4.95 - 16.16)
Observations						
(weighted)	3,186		2,607		2,641	

*Significant level: *** p<0.01, ** p<0.05, * p<0.1.*

Source: Calculated from 2000, 2005 and 2011 EDHS data.

3.1.3 Result of Multivariate Regression Model

In this sub-section results of the analysis of the determinants of U_5M following upon Cox Proportional Hazard Regression Model. There are many determinants of U_5M in Amhara region and it is necessary to analyze them separately in order to get the insight about the variation of particular type of predictor variables.

In the model (Table 3) sex of child is found to be one of the determinants of U_5M. The result revealed that the hazard of female U_5M were (HR: 0.79, 0.86 and 0.54) less likely compared with their male counterparts for the first and last surveys, respectively. The result also showed that children born to mothers at an interval of greater than 2 year experienced a lower hazard of U_5M compared with first births and births with shorter preceding birth interval but the result is statistically significant for the first and second surveys.

Child size (as perceived by mothers) at birth is also one of the determinants of U_5M. Compared to babies of large size, children with average and small birth size were (HR: 0.55, 0.63 and 0.42) and (HR: 0.40, 0.51 and 0.46) less likely to experience the hazard of U_5M with significant level of ($p<0.01$) across the three surveys. The result of our analysis revealed that the influence of maternal education over the years considered in the study is not consistent. While the evidence from the first two surveys suggest that maternal education beyond primary schooling significantly improved child survival, the result from the last survey shown that the observed small positive impact of maternal education on child survival is nothing more than chance variation.

With regard to age of mother at birth of the baby, during the first survey, children born to old women (35+) were (HR: 1.43) more likely to experience the hazard of U_5M. However, during the last two surveys, births to teen mothers (below 18 years) had a disadvantaged survival rate (HR: 1.50 and 2.00) as opposed to births that happen to mothers of age 18-34 years. Another predictor variable of U_5M is marital status of woman. As such, children born to mothers in union are (HR = 0.39 and 0.60) less likely to experience the hazard of U_5M for the 2000 and 2005 demographic surveys than children born out of wedlock.

Women contraceptive use was introduced to the model to measure its impact on the survival status of children. The result revealed that children born to mothers who use contraceptive were (HR: 0.78, 0.87 and 0.65) less likely to experience the hazard of U_5M compared with children born to mothers who were not using contraception, respectively; however, the result was statistically significant ($p<0.05$) only for the last survey.

The place of residence was found to have no consistent impact on child survival. During the first survey, it was observed that children born to mothers in rural area were (HR: 0.43) less likely to experience the hazard of U_5M. However, during the second survey, children born to mothers in rural area had a survival disadvantage (HR: 2.47) than children born to women residing in urban area. In the final survey, the significance of place of residence was subsumed by the other predictors included in the model.

The source of drinking water is another determinant that was found to be associated consistently with the survival probabilities of children across all survey periods. The result revealed that children born in households with access to non-improved source of drinking water (river or pond water) were (HR: 2.57, 2.01 and 2.14) more likely to experience the hazard of U_5M compared with their counterpart.

The occurrence of multiple births is another variable for our analysis. The result revealed that, twins were (HR: 9.02, 5.07 and 8.94) more likely to experience a higher hazard of U_5M as opposed to singletons throughout the three surveys with significant level of ($p<0.01$).

3.2 Discussion

Children are the human resource bank of every nation. However, they are known to be more vulnerable to diseases and susceptible to various health hazards. In order to look at the determinant of U_5M in Amhara National Regional State, Cox Proportional Hazard regression model was employed and the results obtained are discussed as follows.

The discourse on sex differences in child survival is yet inconclusive. There is no consensus in the literature on male-female differentials in U_5M. Available evidence shows that male children enjoy a numerical advantage over females at the time of birth (Koenig and D'Souza, 1986). However, male children are thereafter susceptible to higher mortality hazard than females. Many empirical studies (Pebley and Amin, 1991; Sastry, 1996 and Boco, 2010) confirm that higher mortality among males during childhood might be the result from a complex interplay of biological, genetic, social and environmental factors. The finding from our study is consistent with the previous literature (D'Souza, Stan, & Chen, Lincoln C., 1980; Waldron, I., 1983; Wingard, D.L., 1984; Waldron, I., 1998; Kummar and Gemechis, 2010; Adepoju et al., 2012; and Mekonen et al., 2013) that the hazard of U_5M is higher for males than females.

Since most births in the region occur at home, children's actual birth weights were unavailable for most children. Instead, mothers were asked whether their child was very large, average, or small at birth since this has been found to be a good proxy for birth

weight and the reported birth weight may not be best estimates of the prevalence of low birth weight among all children. Therefore, results regarding birth weight shall be interpreted cautiously as this measurement could be subject to measurement bias. The finding of the three DHS however revealed that large size child at birth experiences the greatest hazard of U_5M than small and average size child and the result is inconsistent with the previous research finding (Bailey M., 1989; Manda SO, 1999) and is not in line with the hypothesis and this may needs further investigation.

Birth interval is an important determinant that has a significant effect on a child's chances of survival. A number of studies have shown that increased U_5M risks among children born after short birth intervals (Sweemer, 1984 and Gubhaju, 1986). Children born too close to a previous birth, especially if the interval between the births is less than two years, are at increased hazard of health problems and death at a young age. Hobcraft et al. (1985) in their analysis revealed that any birth that occurred within 2 years of the previous birth was linked with considerable U_5M. This is attributed, short duration of birth intervals is associated with adverse pregnancy outcomes, increased morbidity during pregnancy and increased the risk of U_5M (Rustein, 2005). Thus, our finding is consistent with the earlier findings (Sweemer, 1984; Boerma, J.T. and Bicego, G.T., 1992; Manda, S.O.M., 1999; Mondal et al., 2009 and Yigzaw, M., and Enquselassie, F., 2010) that as child spacing increases the likelihood of U_5M reduces.

The negative relationship between maternal education and U_5M is almost a universal fact. Education; mother's education in particular, is one of the most frequently described social determinants of U_5M in developing countries. Empirical evidence (Houweling and Kunst, 2010) strongly suggests that educated women have fewer and more healthy children than the less educated ones. Higher educational attainment of women are generally associated with lower U_5M, since education exposes mothers to information about better nutrition, use of contraceptives to space births and knowledge about childhood illness and treatment. However, it can be noted that literacy level is still low in the region. The percentage of women accessing and completing primary education has improved over the years but the level of secondary education is not yet reached at the desired level. The finding of the three DHS revealed that a higher level of educational attainment, particularly secondary education, leads to reduction of U_5M in the region. This has long been acknowledged by previous studies in that education of mother particularly secondary education is a significant determinant in alleviating U_5M (Caldwell, J. C., 1979; Cleland, J.G. and Van Ginneken, J.K., 1988; Schultz, 1993; Kaufmann G. and Cleland, J. 1994; Fuchs and Lutz, 2011 and Song and Burgard, 2011).

Several studies (Mosley and Chen, 1984 and Hobcraft et al., 1985) illustrate that U_5M is high for very young mothers (<18 years), falls to the lowest for women aged between 25 and 30 and then rises steadily with the age of mother 35 and above. Children born to teenage mothers are known to be at higher risk of U_5M due to physical immaturity of teenagers and children born to old women (35+) may experience age related problems during pregnancy and delivery. Our finding is in line with the available previous literature (Baldwin, W. and Cain, V.S., 1980; Kibet, 2010 and Worku, 2009) that maternal age at the time of birth is a strong predictor of U_5M.

Concerning evidence on the relation marital status of women with U_5M, studies have been very scant. However, one can sense that mothers in stable marriages would get support from their partners during antenatal to postnatal care which can reduce risk of U_5M. Previous researches demonstrated mixed findings. The finding of (Kanmiki et al., 2014) in Ghana revealed marriage may confer advantages such as pooling of resources to either patronize good health services or provide adequate care with respect to providing good nutrition to children and result in diminished hazard of U_5M. In addition, the finding of Rahman, O. (1993) and Clark and Hamplová (2013) show children born out of marriage were more likely to die as compared to those children born to married women which are consistent with the finding of the first two surveys in Amhara region. On the other hand, finding from a study conducted in Ghana (Goro, 2007) revealed that children born to married women have higher chances of U_5M than their counterpart in the Upper West region which is consistent with the finding of the last survey in Amhara region.

The benefits of using contraception have been widely explained in different literature. Contraception has a way of militating against incidence of unwanted pregnancy and it enhances adequate child spacing. It ensures that only children that were planned for will come to life and these will improve their survival. Moreover, it helps to improve the health of mothers and children as well as contribute to the reduction of fertility and U_5M. As shown in the result, a reduced likelihood of U_5M was observed among mothers who use contraception during the recent survey period which is also consistent with previous findings (Goro, 2007; Adhikari and Podhisita, 2010 and Saha, U.R., and Soest, A.V., 2013).

Although the living conditions in rural areas were associated with poor health condition, lack of access to safe drinking water, poor infrastructure, lower age at first marriage, delivery with poor hygienic and lack of personal hygiene, which were the

risk factors of U_5M, on the contrary the finding from the first survey shows children born in rural area were less likely to die than their urban counterparts in Amhara region. This is opposite to what other studies suggest. On the other hand, the investment in infrastructure, education, public health and medical facilities are generally greater in urban areas, and therefore, U_5M is lower in urban areas and finding from the 2005 survey reveals consistent result with the previous findings (Reddaiah, V.P. and Kapoor, S.K., 1992; Ettarh and Kimani, 2012 and Chowdhury, 2013) that the hazard of U_5M is lower for children born in urban than rural areas.

Safe drinking water is a basic necessity for good health, which has a direct bearing upon the health of the child. Globally, it is estimated that a child dies from a water-related disease every 21 seconds (Water Organization, 2014). The majority of these deaths occur in sub-Saharan Africa where nearly half the population lacks access to improved water. Unimproved water source is a leading cause of childhood diarrhea and cholera and has long been documented in demographic and public health literature. In response to this in the past decade Amhara regional government has implemented different water supply policies and strategies. Despite all this effort, large segment of the population of the region still lack access to improved source of drinking water which may increase the hazard of U_5M. The findings from the three DHS is consistent with the previous studies (Merrick, T.W., 1985; Esrey, S.A. and Habicht, J.P., 1986; Woldemicael, G. 2000; Hala, A., 2002; Fotso et al., 2007 and Samuel and Eshetu, 2012) that the hazard of U_5M is higher in household whose source of drinking water is unsafe.

Literature revealed that children from multiple births (twins) experience much higher mortality than singletons. The higher hazard among multiple births might be due to biological factors such as low birth weight and complications at delivery. The finding from the three demographic surveys is consistent with the previous research (Asefa M, Drewett R. and Tessema F., 2002 and Alam, van Ginneken, and Bosch, 2007) that children of multiple births have a remarkably high U_5M than their counterparts.

4. Conclusion and Policy Implication

4.1 Conclusions

Our study clearly shows a significant decline in the rate of U_5M in the Amhara region from 2000 to 2005 by 16 percent and further decline (2005 and 2011) by 30 percent. The decline in U_5M resulted in large part from the substantial improvements in public health services between 2000 and 2011. Important improvements were made in maternal and child health, specifically in antenatal care by qualified health professionals and in tetanus toxoid vaccine injections given during pregnancy, and also in reproductive health and family planning. It is evident from this analysis that policies and programmes that support the provision of services for maternal and child health, reproductive health, and family planning continue to improve child survival in Amhara region.

However, an U_5M of 108 deaths per 1,000 live births in the region is still high. The probable reason for such high U_5M could be the existence of inequalities in health care services and poor care seeking behaviour for childhood illness and poor targeting, poor infrastructure, malnutrition and so on. This is challenging task given the past track record as well as major unmet needs for child survival in the region. Thus, in-depth understanding of the differentials and determinants of U_5M in the region is crucial in any attempt to attain the goal of reducing U_5M level through proper and sustainable intervention strategies.

The findings of this research imply that women education is the cornerstone to improve child survival means that child survival increases with increase in mother's education level particularly secondary level education. In addition, in all the three surveys the study revealed that the age of mother at birth was an important factor determining U_5M. The study further discovered U_5M risks vary significantly with the availability of improved source of drinking water. The risks of U_5M were most likely for children born in household who did not have access to improved water source. The study also concludes an increase in contraceptive prevalence among married women in ANRS over the past decade, from seven percent in 2000 to 33 percent in 2011, has contributed to the reduction of under-five mortality rates.

4.2 Policy Implications

Finding of this study can have a number of important implications for policy, programme and research. Thus, to sustain the current reduction in U_5M, the following should be made by the regional government as well as concerned Non-Governmental Organizations in the region.

- Reach and invest in women with no or primary education particularly in rural area. Women education is central to lower fertility, mortality and morbidity. It has also a significant effect on child survival. Increasing the availability of secondary education to women will substantially decrease the risk of U_5M. This is because; an educated mother is needed to increase the chance of child survival. Hence, women education particularly secondary level should be encouraged in the region in order to improve child survival.
- Improving basic amenities. The finding revealed that improvement in the source of drinking

water is most crucial to reduce U_5M in the region. Programmes aim at improving the accessibility of improved water is an important intervention to reduce U_5M. It is known that majority of Amhara region population resides in rural area. Much of the population does not access to safe drinking water. Accordingly, many children died due to water born disease. These in turn affect child survival strategies. Hence, provision of clean water to households particularly in rural areas will greatly improve the survival of children in the region.

- Strengthen the family planning service needs of the community in the future. The role of family planning in improving child survival has long been established in many studies. With further decline in U_5M, there is a potential for the demand for family planning to continue growing in the region. Family planning programmes have encouraged by regional government in order to longer birth interval, improve child and maternal health, lower population growth rate to a manageable size and reduce U_5M. Hence, integrating family planning with maternal and child survival programmes should be given high priority as this has an added effect on child survival and thereby fertility reduction. Thus, the current attention of the regional government to family planning programme should be sustained in the future.
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5. Study Limitation

U_5M studies are generally faced with data limitations, particularly in developing countries. Death is regarded as a sad event that respondents are reluctant to recall. Mothers may be reluctant to talk about their dead children either because it brings back sad memories or because their culture discourages mention of the dead. Data in the birth history used to calculate U_5M rates necessarily depend on women's memories and thus are subject to recall bias. Recall bias could affect the calculation of U_5M rates in many ways, such as omissions of deaths, incomplete information on date of death, displacement of the date of death, and misreporting age at death. These biases inevitably occur in retrospectively collected data. If the biases are minimal they will not significantly affect the calculation of U_5M rates. If the biases are large, however, they will severely affect the calculation of U_5M rates. Thus, this study drew on secondary data set; as a result, there was a tendency for U_5M to be under-reported. As can the omission of deaths affect the quality of U_5M data, so can the misreporting of age at death (heaping or avoidance) distort the age pattern and quality of the U_5M data.

Declaration

This article is original; it is not considered elsewhere and there is no conflict of interest.

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