The Effect of Maternal Education on Under-five Mortality in Ethiopia

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List of Acronyms

BMI	Body Mass Index
CSA	Central Statistical Authority
EDHS	Ethiopian Demographic and Health Survey
HEP	Health Extension Program
HSDP	Health Sector Development Program
ISS	Institute of Social Studies
LPM	Linear Probability Model
MDGs	Millennium Development Goals
MoH	Ministry of Health
SNNP	Southern Nations and Nationalities Peoples
U5M	Under-five Mortality
UNDP	United Nations Development Program
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development

Abstract

This paper aimed at contributing for the understanding of factors determining child health by investigating the effect of maternal education on occurrence of under-five mortality.

The objectives of the study were to determine the effect of formal maternal schooling on under-five mortality and identifying channels through which maternal education may affect under-five mortality for the period between 2000 and 2011. The data was obtained from the 2000, 2005, and 2011 EDHS. The total number of observations used in the LPM regressions are 9765, 9532, 10975, and 25829 for the years 2000, 2005, 2011, and the pooled regressions respectively. Set of factors related to socio-economic status, use of health care services, reproductive behaviours of women, mothers' empowerment, and maternal employment status were included in the regressions made to find the partial effect of maternal schooling on incidence of under-five mortality. On the other hand, these variables were tested for their mediation of the effect of maternal education on under-five mortality.

Mean of incidence of under-five mortality has decreased from 2000 to 2011. It also decreases with increasing levels of maternal education. Similarly, significantly higher mean of years of schooling was obtained for mothers whose children are alive. In addition, children alive are better off in other family and maternal characteristics including family wealth index, pre-birth interval, type of floor materials, sanitation services, drinking water, visiting health facilities, modern contraceptive use, antenatal visit, and delivery in health facilities.

In all 2000, 2005 and 2011, formal maternal education had significant total effect on under-five mortality. In 2000 and 2005, part of its effect was mediated by other factors. In 2000, almost 50% of the total effect of maternal education was mediated through socio-economic factors. In 2005, both socio-economic factors and attitude towards health care service utilisation were the channels through which maternal education affect under-five mortality. For 2011, no pathway mediated its effect. This could be mainly due to the universal access to health facilities and health knowledge created for the people of Ethiopia after the introduction of Health Extension Program (HEP) from 2003. But, there is significant direct effect of years of maternal schooling in 2011, which may have happened due to the difference in the impact of HEP with difference in maternal education. Though, the total effect from maternal education has decreased, more educated mothers are better off in absorbing the benefits of health infrastructure and health knowledge that are universally available.

The results imply that big part of the effect of maternal education can be substituted by investing in other factors that can improve socio-economic status, use of health services, and health behaviours of women. It is seen by the change in the effect of formal maternal schooling after the introduction HEP. But, investment in girls' schooling is still one of the important ways to contribute for child health improvement in the long run.

Relevance to Development Studies

Child health is one of the main indicators of development of a country and under-five mortality is one of the most used measures of child health. The main causes of child death in developing countries are preventable and curable that happen mainly due to low level of development. This makes under-five mortality a development issue. Therefore, by helping to understand the long term effect maternal education had on under-five mortality, this study contributes for the literature of development studies.

Keywords

Channels, Determinants, Ethiopia, Maternal Education, Linear Probability Model (LPM), Under-five mortality

Chapter 1
Introduction

1.1 Background

Child health in general and childhood mortality in particular are often used as broad indicators of social development (Zachary et al. 2013). That is why reducing child mortality is one of the eight millennium development goals (MDGs) designed in 2000. MDG 4 was set to reduce under-five mortality by two-thirds in the year 2015 from its 2000 level. Under-five mortality continued to decline in the world and it was estimated to be around 7.2 million in 2011 (Lozano et al. 2011). According to the same source, compared to the 1990-2000 period, 106 countries could achieve accelerated decrease in under-five mortality during the period 2000-2010. But, the effort for reducing the under-five mortality rate is generally slower than the rate planned. Therefore, though the achievement on reducing under-five mortality is increasing in most countries, many countries will not be able to achieve the MDG 4 targets by 2015 (Lozano et al. 2011).

Ethiopian government has also committed to MDGs and it is making many interventions in the areas. Childhood mortality is decreasing in Ethiopia. For example, under-five mortality has decreased from 123 deaths per 1000 live births in 2005 to 88 deaths per 1000 live births in 2011 (ICF International, 2012). At this rate, Ethiopia has the second highest under-five mortality rate in East Africa, next to Uganda. It shows that, despite good achievements, Ethiopia still has high under-five mortality rate. It is still higher than the target of under-five mortality rate of 67 deaths per 1,000 live births which Ethiopian government has committed itself. Therefore, progress on child mortality in Ethiopia needs continuous attention.

Child health can be measured using different indicators like nutritional status, child mortality and immunization status. Indicators of child health related to child mortality include neonatal mortality, post-neonatal mortality, infant mortality, child mortality, and under-five mortality. Among these, under-five mortality is considered as a leading indicator of child health and overall development of a country (The DHS Program, 2014). Therefore, this study used under-five mortality to explore child health status.

Child health is determined by many factors including parental education[1], access to health services, and income of families. According to Mosley and Chen (1984), child mortality is determined by a combination of socio-economic, biological, environmental, and behavioral factors. A study on developing countries by Caldwell and McDonald (1982) also showed the significant effect of increasing maternal education on reducing child mortality. The study put the importance of maternal education even higher than the effects of income and access to health facilities combined. It also claims that for many decades, social change (mainly education) has important effect than technological and economic changes. Cochrane et al. (1982) also explained the relationship between parental education and child health. By measuring child health through nutritional status, morbidity and mortality, it found a significant effect of parental education on child health. According to this study's result, income differences do not explain even half of the effect of parental education.

[1] Unless explicitly referred to other type of education, the word education in the paper refers to formal education obtained in schools.

Cochrane et al. (1982) found mothers' education having twice the effect of fathers' education. Similarly, Desai and Alva (1998) stated that maternal education has significant effect on children's immunization in many countries. Furthermore, it affects infant mortality and height for age in some countries. Mother's education is important for health of children, after controlling for income, number of siblings, health environments and other socio-economic variables (Chen and Li 2009). In addition to household resources and food prices, parental education is a key determinant of child malnutrition in Ethiopia (Christiaensen and Alderman 2004). By referring to examples from the Philippines, Pakistan, Ghana and Jamaica, the study states that maternal education has great importance in improving child nutrition status.

But, the mechanism through which maternal education affect child health is not clear, as it can be either one or combination of nutrition, income, fertility, and other factors (Cochrane et al 2004). Maternal education can have direct effect on difference child health indicators as reported by many studies (Mekonnen 2011, Mohammed 2013, Mulugeta 2012). On the other hand, maternal education will affect child health through other factors[2]. For example, Frost et al. (2005) found that socio-economic factors are the most important pathways that link maternal education and child health (measured by nutritional status). Similarly, in a study on Pakistan, mother's health knowledge and her bargaining power in the household are the main pathways through which maternal education affects her child's health status (Aslam and Kingdon 2012). These studies discussed that maternal education influences factors like socio-economic status, health knowledge and mothers' bargaining power in the household which in turn affect child heath indicators. This explains the indirect effect of maternal education on child health through other channels, in addition to its direct effect.

The effect of maternal education on child health can be seen through its effect on different health indicators. Some studies have discussed the effect of maternal education through its effect on child mortality, nutritional status, and morbidity (like Caldwell and McDonald 1982, Cochrane et al. 1982, Frost et al. 2005). These studies have identified the effect of maternal education on child nutritional status and childhood mortality and the channels through which maternal education affect them.

1.2 Justification

The trend in demographic and health indicators from 2000, 2005, and 2011 Ethiopian Demographic and Health Surveys (EDHS) show improvement of child health status (Zachary *et al.* 2013). Early childhood mortality (all neonatal mortality, post-neonatal mortality, Infant mortality, child mortality, under-five mortality) have been decreasing. In addition, child immunization, and child treatment has increased and the percentage of stunted children has been decreasing. Specifically, under-five child mortality has decreased by 50% from 166 to 88 deaths per 1,000 live births in the period between 2000 and 2011. But, as discussed above, even if mortality has decreased, it is not as fast as needed. Still, Ethiopia is at lower position than other East African countries in terms of many child health indictors (ICF International 2012).

Studying trend of determinants of under-five child mortality therefore helps to identify the factors that affect child mortality overtime. By looking at the trend, factors which are determining the

[2] Hereafter, we may use the words *channels, pathways,* or *mechanisms* to express the factors through which maternal education may affect child-health indicators (under-five mortality for this study).

rate can be compared across time. It helps to analyze whether correct targeting has been made by the government and other agents.

On the other hand, the same data on 2000, 2005, and 2011 show that education level of women has increased (ICF International 2012). It is not only increasing, but it is also one of the main determinants of infant and child mortality in Ethiopia (Mekonnen 2011). Similarly, exposure to mass media and information (percentage of people with a television and phone), knowledge of family planning and current use of family planning have increased (ICF International 2012). Related to these, fertility rate has also been decreasing. These factors and others may have contributed for the improvement in child health indicators.

In addition to the trend of its effect, this paper will analyze the pathways through which maternal education affect occurrence of under-five mortality. Mother's education is expected to affect child health through different channels. When mothers' education level increase, their knowledge related to nutrition, disease, and other related issues will be improved. In addition, their attitude towards using modern medicine and usage of health service will increase. Similarly, higher maternal education may be related to greater women autonomy in the household which helps for the improvement of the child health. Therefore, it is important to identify the mechanisms through which maternal education affects child health. Knowing the mechanisms through which education affects under-five mortality helps to stress on its big importance so that it can get enough attention besides the other factors. It will also help to provide an assessment of substitutes which may be used in place of maternal education, especially as providing mothers with formal education will take long time and will be helpful only to the generations to come.

Generally, analyzing in issues related to progress in under-five mortality is vital since it helps for the better mobilization of limited resources through identifying better areas of intervention. In addition, this research is useful to analyze the effects of intervention by the Ethiopian government and other stakeholders.

Based on the above premises, this paper will determine the trends in the determinants of under-five mortality in Ethiopia for the period between 2000 and 2011 using EDHS data on 2000, 2005, and 2011. In addition, the study will identify the main channels through which maternal education affects under-five mortality in Ethiopia over the same time period.

1.3 Research Objectives

The objectives of the research are:

- To determine the factors that affect under-five mortality in Ethiopia over the period of 2000 to 2011, with special focus on formal maternal education, and
- To identify the main mechanisms through which maternal education affects under-five mortality.

Chapter 2
Review of Related Literature

The first section of this chapter discusses the theoretical foundations of the determinants of under-five mortality and the channels of the effect of maternal education on under-five mortality. The second section reviews the results of empirical studies on similar issues.

2.1 Theoretical Framework

This sub-section discusses the theoretical bases of the study. First discussed is how different factors affect child mortality. It is followed by a discussion on how maternal education can affect child mortality directly and/or indirectly through other factors.

Mosley and Chen (1984) developed analytical framework for the study of child survival applicable to developing countries. The framework integrates both social and biological factors that have effect on mortality. The authors have grouped these proximate determinants of morbidity and mortality into five groups. These include; maternal factors, environmental contamination, nutrient deficiency, injury and personal illness control. The figure given below (Figure 1) shows the way these factors affect child mortality. It also shows the presence of interrelationships among different determinants. In addition, it is shown when the identified factors affect mortality status (health) of a child directly by themselves or/and indirectly through other determinants.

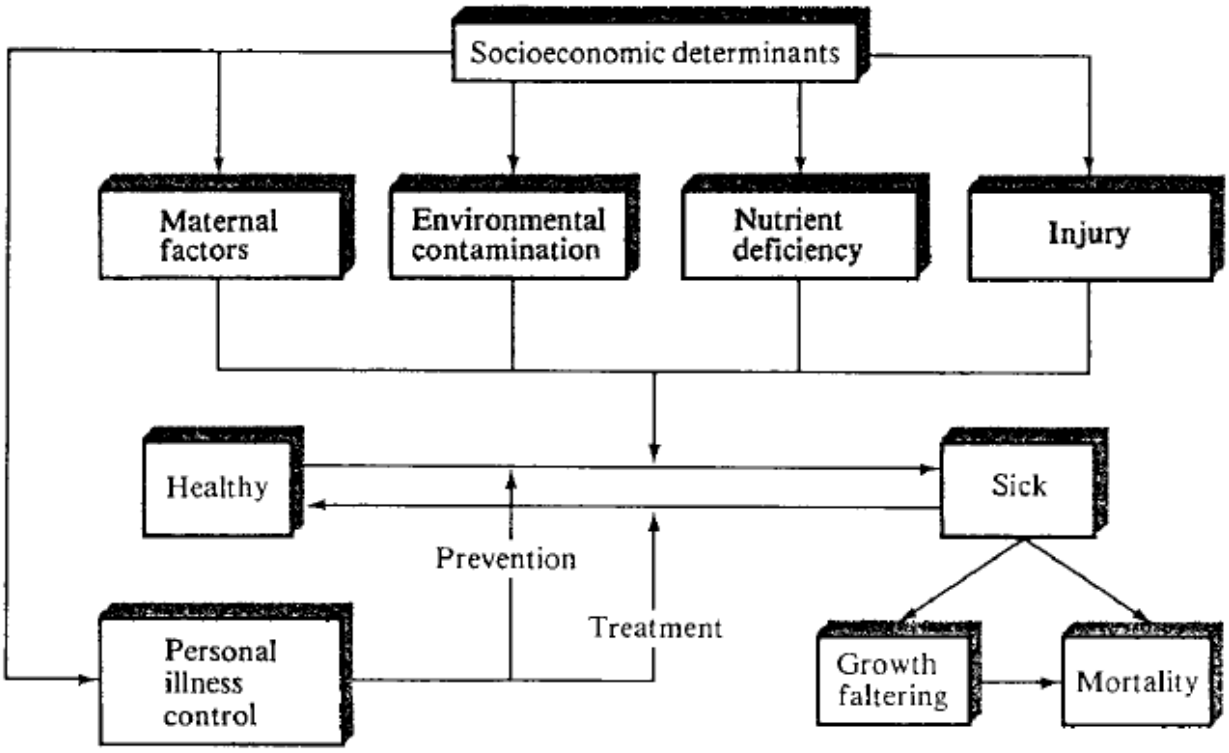

Figure 1: Conceptual framework of determinants of child mortality
(Source: Mosley and Chen 1984:142)

The maternal factors listed by Mosley and Chen (1984) include age, parity, and birth interval. The environmental factors on the other hand are quality of air, food, water, and others. Injury, personal preventive measures, and medical treatment are among the determinants of child mortality identified. A direct measure is available for some of these factors and others can be measured indirectly through proxies.

Both maternal and paternal education are among the socio-economic factors that affect child mortality. Especially, maternal education has been one of the main determinants of child health indicators and child mortality in many studies (Mekonnen 2011, Mulugeta 2012). One of the reasons given by Grossman (2006) is because child care is the main responsibility of mothers, when they become more educated they can provide a better care for their children. Mosley and Chen (1984) found that maternal education, besides to income, is the most common determinants of child mortality in developing countries. Caldwell and McDonald (1982) and Kradval (2004) also showed the significant effect of maternal education on reducing child mortality. Cochrane et al. (1982) on the other hand found positive effect of parental education and child health measure of mortality, morbidity, and nutritional status. Similarly, mothers' education was one of the factors that was significantly associated with child immunization in Nepal (Pandey and Lee 2011) and significantly higher child survival in India (Govindasamy and Ramesh 1997).

Many Studies have showed that the effect maternal education has on different child health indicators can be direct and/or indirect. The mechanism through which maternal education affects child health can be either one or combination of nutrition, income, fertility, and other factors (Aslam and Kingdon 2012, Cochrane et al. 1982, Frost et al. 2005, Kassauf and Senaur 1996). These studies have tested different combination of factors for their mediation of the effect of maternal education on different child health measures. Cochrane et al. (1982) tested for the effect of maternal education on child nutritional status through improved knowledge on preventive and curative health issues and increased income. On the other hand, Aslam and Kingdon (2012) and Frost et al. (2005) have studied of socio-economic factors, mothers' information access, labor force participation and other factors for their mediation of the effect of maternal education.

The following diagram (Figure 2) is drawn based on the above discussion and it shows the way maternal education can affect under-five mortality. It shows its direct effect and indirect effect it employs through other channels.

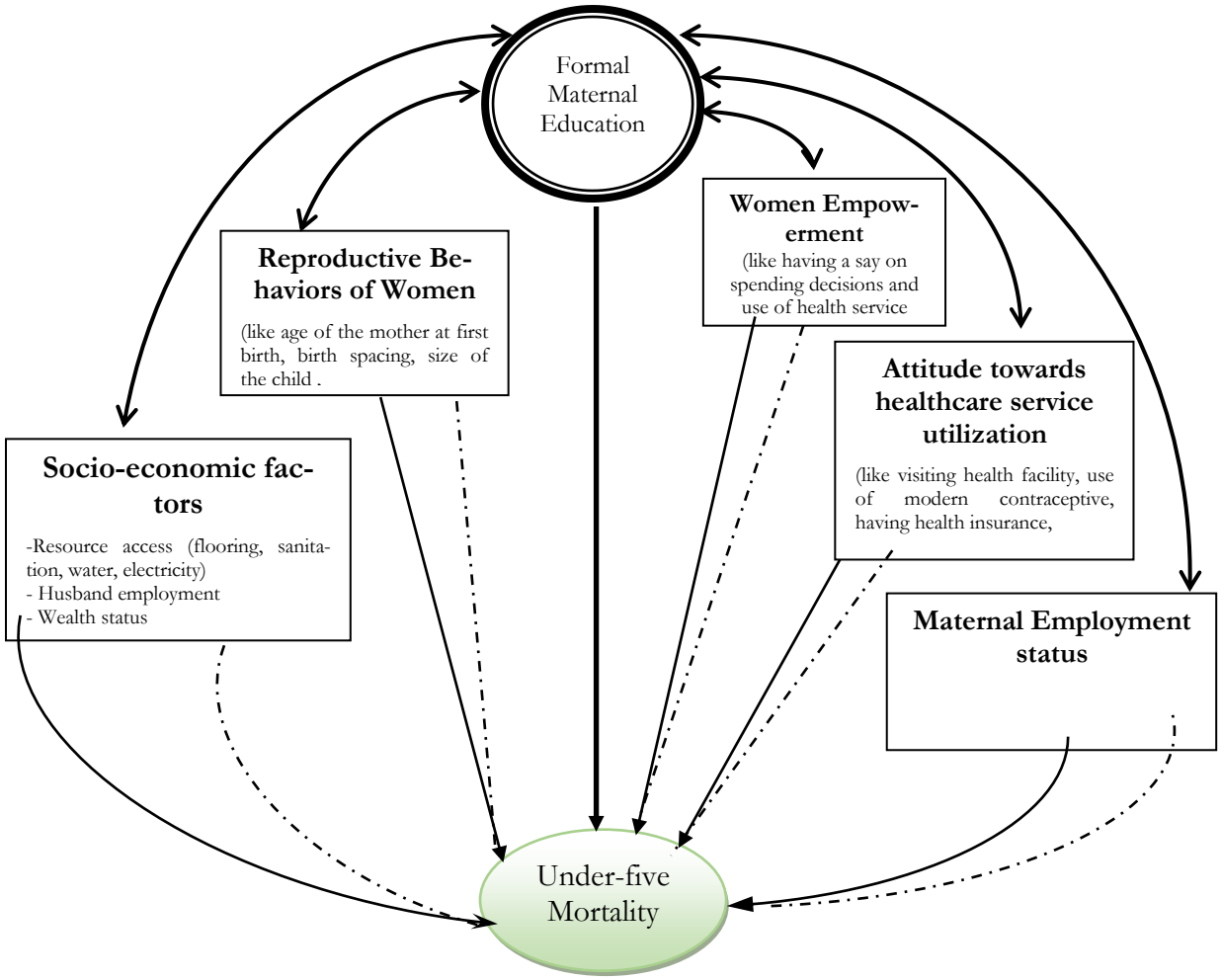

Figure 2: Channels through which maternal education affect child health [3]

The figure above shows the channels through which formal maternal education may affect under-five mortality and the directions of the effect. The figure contains formal maternal education at the top and groups of other factors that are potential determinants of under-five mortality are depicted to the bottom right and left. Then, under-five mortality at the bottom. The bold two way arrowed lines drawn from maternal education to other groups of determinants show the possible association exist between them. The bold line drawn from maternal education to under-five mortality shows the direct effect of education on reducing under-five mortality.

The group of factors that are shown inside the rectangles of the above figure (Figure 2) are among the main determinants of under-five mortality that are discussed in the above sub-section. We can divide their effect into two for the interest of this paper. The two lines drawn from the rectangular boxes to under-five mortality show this two types of effects. The broken lines represents the effect these factors exert on under-five mortality because they were affected by formal educa-

[3] There will also be association between the different factors (channels) depicted in the picture, but lines are not included to keep the image visible.

tion. This broken line exists only if maternal education affects those identified channels and if the effect is also strong enough to affect under-five mortality. The solid lines drawn from the boxes to under-five mortality show the remaining effect of those factors. Therefore, the total effect of maternal education is the sum of the direct effect (the bold line from maternal education to U5M) and its indirect effects (the broken lines from the boxes to U5M.).

2.2 Empirical Review

2.2.1 Determinants of Childhood Mortality

Reducing under-five mortality by two thirds in the year 2015 from the level it was in 2000 is one of the targets of the Millennium Development Goals. In 2011, infant mortality was estimated at 59 deaths per 1,000 live births for the five-year period before the survey, which has decreased from 77 deaths per 1,000 live births during 2005 survey (ICF International 2012). Similarly, in 2011, under-five mortality level has decreased to 88 deaths per 1,000 live births, from 123 deaths per 1,000 live births in 2005. There was a 47% decline in under-five mortality during the period of 2000 and 2011. Despite the fast reduction, under-five mortality is still high compared to the goal set in MDG4 and the under-five mortality in the other Eastern African countries.

The figure below shows the trend in childhood mortality in the period 2000 to 2011.

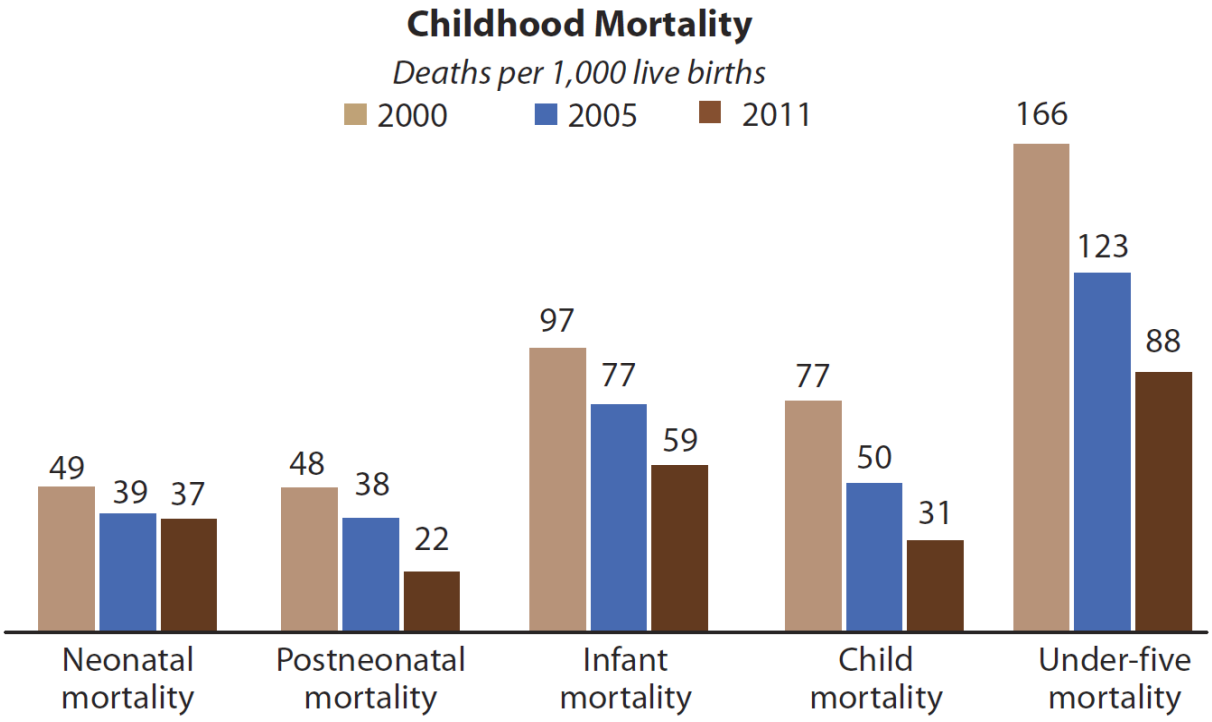

Figure 3: Trend in childhood mortality (adopted from ICF International 2012:4)

ICF International (2012) stated that mortality rates in Ethiopia differ by region. The report also showed that under-five mortality differs by difference in mothers' education. During the 2011 Ethiopian Demographic and Health Survey (EDHS), under-five mortality for children born from mothers with no education was 121 per 1,000 live births, while the mortality rate for children born from

mothers with above secondary education level is as low as 24 deaths per 1000 live births. From this report, another important factor where under-five mortality rate differs by is birth spacing. A minimum of 36 months birth spacing between children is important to reduce the risk of death. But, children who are born with lower than two years spacing have got a higher risk of death.

Different studies have found significant bio-demographic and socio-economic factors that determine neo-natal mortality, infant mortality and child mortality. These factors include; marital status, birth order of the child, preceding birth interval, maternal education, household size, and sex of the child (Dejene and Girma 2013, Mekonnen 2011, Mekonnen et al. 2013). In addition to these factors, age of the mother at first birth, number of children born to a mother, access to sanitation facilities, quality of water, and access to radio are the factors that found to significantly affect childhood mortality (Mulugeta 2012). Similarly, maternal health, household income and maternal education were significant determinants of child nutritional status (Mohammed 2013). Maternal education was one of the main determinants of child health identified by all of these studies. But, they have studied only the direct (partial) effect of maternal education. Our study, on the other hand, focuses on how the effect of maternal education evolved over time and how the effect of maternal education work through other factors i.e., on the overtime direct and indirect effects of maternal education on under-five mortality.

Similar studies have been done for other countries. For example Aderinwale (2013) in the study for the determinants of under-five mortality in Nigeria has found significant effect bio-demographic and environmental factors. Availability of public services like electricity, public toilets, proper sanitary disposals and piped water were also found to be among important factors that determine child survival in the same country (Adebayo and Fahrmeir 2005). The other important factor identified by this study is time and duration of breast feeding. In addition, they stated that mother's increased participation in outside-home employment negatively affected probability of child survival.

In Nepal, mother's education and her decision making power in the household are the most powerful determinants of infant mortality (Adhikaril and Sawangdee 2011). That is why they recommended for the empowerment of women to achieve a great success in reducing infant mortality in the country to the extent that it helps for the achievement of MDG4 in 2015. Educating women is the most important related factor which this study has recommended to be focused on achieving the objective of reducing childhood mortality. In addition to mother's education and autonomy, the main socioeconomic and demographic variables that were significant determinants of infant mortality in this study include; age, religion, number of children, previous birth spacing, sex of the child, area of residence, ecological zone, wealth status of the household, source of drinking water, and availability of facilities. Andoh et al. (2007) also found that sex of the child, birth interval and mother's occupation are significant determinants of child survival in Cote D'voire. Furthermore, Factors related to childcare environment are important to improve the survival status of children.

2.2.2 Mechanisms through which maternal education affect child mortality

Many studies showed the existence of negative relationship between maternal education and child mortality (Buor 2003, Caldwell and McDonald 1982). But, many other studies claim that maternal education affect child health not only directly, but also indirectly through other factors. The main pathways which are mostly tested for mediating the relationship between maternal education and child health are socio-economic status, health knowledge, attitudes towards modern health care, women autonomy, and fertility (like Aslam and Kingdon 2012, Buor 2003, Frost et al. 2005,). Each of these categories can be represented by a combination of factors. For example, socio-economic

status of a household is captured by combining factors like household wealth, husband education level, and husband occupation.

Frost et al. (2005) found that socio-economic status is the most important channel which links maternal education and child nutritional status. As Cleland and Van Ginnken (1988) stated education is an indicator of socio-economic status of a household. This study states that income, water, latrine facilities, housing, and other related factors are economic advantages associated with education. Almost half of the relationship between education and mortality is explained by these channels.

On the other hand, maternal education helps to have better health knowledge and contributes for the improvement of child health and therefore a decrease in probability of childhood death. Formal education helps mothers to easily understand health education. Barrett and Browne (1996) stated that educated mothers can better understand messages of health education than the uneducated counterparts. This caused a difference in utilization of the health services available, despite equal access to the health services regardless of educational difference. There are some countries where health care service access is differed by differences in maternal education (Cleland and Van Ginneken 1988). By looking at the interactions among mother's education and public health programs, Barrera (1990) said that maternal education affects child health through efficiency and allocative effects. It stated that maternal education helps to increase productivity of health inputs and reduces cost of information.

Mother's health knowledge and her empowerment in the household are the main channels thorough which her education level affects her child's health (Aslam and Kingdon 2012). Similarly, Buor (2003) found a significant effect of use of basic health services on childhood survival and its significant association with maternal education. Attitude towards healthcare activities which directly affect nutritional status of children is also related to maternal education (Frost et al. 2005). In this study, pathways including socioeconomic factors, attitudes to health care services, health care knowledge, women autonomy, and reproductive behaviors constituted for almost 60% of the effect maternal education has on nutritional status of children.

Chapter 3
Methodology

3.1 Data Source

The Data used in this study was obtained from 2000, 2005 and 2011 Ethiopian Demographic and Health Surveys (EDHS). The EDHS surveys were conducted as part of the worldwide Demographic and Health Surveys project funded by the United States Agency for International Development (USAID) with technical assistance from ICF International.

The EDHS surveys collect data on a combination of factors including fertility, family planning, contraceptive use, maternal and child health, nutrition and breastfeeding practices, and HIV/AIDS and other sexually transmitted diseases (STDs). The data collection was designed to yield a nationally representative sample.

The number of children used in the study are 10143, 9861, 11654 and 29893, for 2000, 2005, 2011 and the total respectively. But, due to missing values the number of observations used in the regressions are 9765, 9532, 10975, and 25829 for the years 2000, 2005, 2011, and for the pooled data.

The 2000 EDHS did not include information on some variables and it limited our analysis on 2000 and the pooled data to lower number of observations.

3.2 Methods of Data Analysis

After cleaning the data socioeconomic, demographic, and behavioral characteristics of observation are summarized and discussed. Then, regressions are done. The specification of the model used, the list of the variables and included and the way they are used in analysis is summarized below.

3.2.1 Determinants of Under-five Mortality

The dependent variable is dichotomous, which denotes the incidence of death of a child below the age of five in the five years preceding the surveys of 2000, 2005, and 2011 EDHS. Linear Probability Models (LPM) were estimated to find the determinants of under-five mortality. Separate LPM estimates are provided for each of the surveys and the pooled data. The model is specified as follows:

$$C_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_n X_n + \varepsilon_i, \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Where;

C_i is the occurrence of death of a child before the age of five (1 if the child died and 0 if not),

$X_1, , , X_n$ are the independent variables (socioeconomic, biological, behavioral, and environmental factors),

β_s are the coefficients that are estimated from the model, and

ξ_i is the error term that represents the unobserved factors that would have effect on under-five mortality.

Based on the analytical framework developed earlier and including other variables that were used by other studies reviewed, the list of variables used in this study are summarized in Table 1, at the end of this chapter.

3.2.2 Mechanisms through which Maternal Education Affect under-five mortality

The pathways that were tested for their mediation of the effect of maternal education on under-five mortality are socio-economic factors, attitudes to health care service utilization, mothers' reproductive behaviors, women empowerment and mothers' employment status. Geography controls like region, urban/rural, and distance to health facility were introduced to control for the differences in access to health services among observations sampled from different places.

LPM estimates on determinants of under-five mortality were done for different sets of independent variables. The first regression was only on years of maternal education and other control variables including regional dummies, place of residence (rural), distance to health facility, mother's height, sex of the child, and age of the household head. Then, different regressions were done by including the group of variables (pathways) one by one. Finally, all the pathways were included in the regression. Similar steps were followed for estimations on 2000, 2005, 2011 and the pooled data.

The interest here is on magnitude and significance of coefficients for maternal education at different specifications. The effect of a pathway is the difference in the magnitude of the coefficient for maternal education from LPM estimation without the pathway and with the pathway. The change in the significance level of the two coefficients show the strength of association between maternal education and the pathway and therefore reflects the strength of mediation through this pathway. The effect of all pathways is the difference in magnitude of coefficients for education from the regressions with only control variables and with all the pathways included.

$$C_i = \beta_0 + \beta_1 X + \beta_2 Y + \beta_n Z + \xi_i \quad \text{.....} \quad (2)$$

Where;

C_i is the occurrence of death of a child before the age of five (1 if the child died and 0 if not),

X represents a combination of control variables for geographical and access to health facility differences and mother's height, sex of the child, and age of the household head,

Y represents mother's education, and

Z is a pathway that is going to be tested for its mediation between maternal education and under-five mortality (it can be represented by a single variable or combination of variables).

Selection of Pathways

Aslam and Kingdon (2012) and Frost et al. (2005) analyzed different pathways through which mother's education will affect child health on different indicators like nutritional status and immunization. Similarly, this study has analyzed the following groups of variables on their mediation of the effect of maternal education on under-five mortality.

1. *Socio-economic status:* This channel included the variables type of floor material, type of sanitation service, source of drinking water, access to electricity, paternal education,

household size, and wealth status. This channel was chosen based on a premise that maternal education will be highly associated with these factors and these factors in turn will affect under-five mortality. One or more of these factors will definitely affect the incidence of under-five mortality. But, how much of this effect on under-five mortality has happened because these factors were affected by maternal education is what is done by this paper.

For example, more educated mothers will most probably be married to a more educated husband. Ikeako et al. (2006) have found positive and significant association between maternal and paternal education in Nigeria. The educated husband will also be better off in socioeconomic indicators and therefore will be better off in improving child health. Similarly, educated mothers could have better knowledge in the use of sanitary services and were significantly better off in their children's height (Handa 1999). Provision of safe water was found to be another significant determinant of child mortality in India (van der Klaauw and Wang 2011). Therefore, higher maternal education can contribute to lower occurrence of under-five mortality through better socio-economic status.

2. *Attitude towards health care service utilization:* Maternal education level affects their attitude to the use of modern health services. More educated mothers will easily accept use of modern medicine and will be more willing to take their children to health centers. For example, on their study covered seventeen developing countries, Bicego and Boerma (1993) found significant effect of maternal education on the use of health services. Similarly, increasing maternal education has contributed for a significant increase in child survival status in India through its positive effect on use of health services related to prevention of fatal child diseases (Govindasamy and Ramesh 1997). In South-Eastern Nigeria also, formal mothers' education is one of the basic determinants of use of health institutions during delivery (Ikeako et al. 2006). The variables in this group of channels include; visiting health facility, use of modern contraceptive, having health insurance scheme, and religious affiliation.
3. *Reproductive behaviors of women:* Decision related to fertility levels, age at first birth, and birth spacing are also factors that can be directly influenced by education level which in turn directly affect child health. For example, Raj et al. (2010) has found increasing probability of child malnutrition for children born from mothers married at a lower age. In addition; size of the child at birth, the presence of twin, total number of children born from the same mother, parity, and the whether the pregnancy is wanted are included in this channel. Combination of these factors are believed to be influenced by maternal education and they are tested for mediation of the effect of maternal education and under-five mortality.
4. *Women empowerment:* since women are mostly directly responsible for looking after their children, their decision making power is vital for the health of their children. As a women gets more autonomy, they can decide to take their children to health centers, their feeling of responsibility increases which affects their child health positively. Women empowerment in this study is represented by mothers' say on decisions related to household spending and contraceptive use and whether violence is justified from their husbands/partners if they visit their relatives without permission. Though not found significant, maternal empowerment was one of the pathways tested for its mediation of the effect of maternal education in Frost et al. (2005).

5. *Maternal employment status:* This is represented by the status of mothers' participation in a paid work. It is based on the premise that maternal education affect mothers' participation in paid work and the participation paid work in turn will affect child health. In Mozambique, children of unskilled and agricultural workers have higher probability of dying than children of skilled workers (Macassa et al. 2003).
6. *Exposure to Media:* This variable is included on the premise that better educated mothers will be able to easily understand information they get from media sources and will be better-off in reducing the probability of occurrence of under-five mortality. Supporting this hypothesis, Handa (1999) stated that higher maternal education enable mothers to process information faster and efficiently and improves their use of health services and the benefits they get from using the service.

Table 1 below is the whole list of the variables that are used to produce descriptive statistics and LPM estimates. Their expected effect on probability of under-five mortality is given on the last column of the table.

Table 1: Summary of variables used in Linear Probability Model (LPM) regressions of determinants of under-five mortality

Variable name and Description	Measure	Expected sign of influence on probability of occurrence of under-five mortality.
Incidence of mortality for the children below 5 years (under-five mortality)	0 = no, 1 = yes	
Mother education level	Years of schooling	-
Sex of household the head	0=male, 1=female	+(-)
Age of the household head	Age in years	-
Sex of the child	1=female	+(-)
Mother Body mass index (BMI)	BMI in numbers	-
Mother height	Measured in centimeters	-
Current age of the mother	Age in years	-
Floor material	0=earth/sand + dung, 1=improved floor material	-
Sanitation	1=improved toilet facility , 0=otherwise	-
Source of drinking water	1=improved source, 0=otherwise	-
Has electricity	0=no, 1=yes	-
Husband has occupation	0=no, 1=Yes	-
Wealth index	A scale which ranges from 1 to 5 where: 1=poorest, 2=poorer, 3=middle, 4=richer and 5=richest	-
Husband/partner education level	0=no education, 1=primary education, 2=secondary education level, 3=above secondary education	-
Household size	In numbers	+
Mother working a paid work outside home	1=working, 0=not working	
The mother visited health facility in 12 months preceding each survey	0=no, 1=yes	-
The family has health insurance	0=no, 1=Yes	-
contraceptive use	1=Yes, 0=No	-
Is violence justified if wife goes out without telling husband?	1=Yes, 0=No	+
Breast feeding	0=below six months, 1=above six months	-
Who make the decision to use healthcare service	1=only mother and joint decision, 0=only husband/partner	-
Who make the decision to large purchases	1=only mother and joint decision, 0=only hus-	-

Variable name and Description	Measure	Expected sign of influence on probability of occurrence of under-five mortality.
	band/partner	
polygamy	1=Yes, 0=No	+
Age of mothers at first birth	Age in years	-
The child has twin	1=Yes, 0=No	+
Birth order number of the child (parity)	0=first, 1=second/third, 2=fourth/fifth, and 3=six and greater	?
Preceding birth interval	0 if <24 months (reference group=0), 1 if 24-48 months, 2 if >48 months	-
Total children ever born from a single mother	In numbers	+
Wanted pregnancy	1=yes (then/later), 0=No more	-
Mother listens radio	0=no, 1=yes	-
Mother watches television	0=no, 1=yes	-
Mother reads newspapers/magazine	0=no, 1=yes	-
Distance to health facility	0=not a big problem, 1=big problem	+
Place of residence	Rural (=1)	+
Place of delivery	0=home, 1=health facility	-
The mother had antenatal visit during pregnancy	1=Yes, o=No	-
Size of child at birth	1=large (very large, 2=larger than aver-age,3=average), 0=small (smaller than average, very small, don't know)	-
Household has radio	0=no, 1=yes	-
Household has TV	0=no, 1=yes	-
Household has refrigerator	0=no, 1=yes	-
Religion: it includes Orthodox, catholic, protestant, Muslim, traditional, and others	the reference group is Orthodox	?
Regional states (Addis Ababa is a reference group)	Tigray, Afar, Amhara, Oromia, Somali, Benishangul Gumz, SNNP, Gambella, Harari, Addis Ababa, Dire Dawa	?

'+' shows increase in probability of occurrence of under-five mortality,

'- ' shows a decrease in a probability of occurrence of under-five mortality

3.3 Descriptive Statistics

This sub-section summarizes the characteristics of the children, their mothers and their families. First, the characteristics are summarized for different years and the discussion was made comparing the means across time. Then, the summary characteristics are presented and discussed based on incidence of under-five mortality. Finally, the characteristics are summarized for different levels of maternal education and it is discussed for all the years 2000, 2005 and 2011.

Table 2 below shows the number of children sampled and incidence of under-five mortality in each period. The total number of children used in this study is 31658, where 10143, 9861 and 11654 children were used from 2000, 2005 and 2011 EDHS surveys respectively.

Mean of incidence of under-five mortality has decreased from 2000 to 2011. It was 11 % in 2000 and has decreased to 9 % in 2005. In 2011, mean of incidence of under-five mortality has decreased with the same 2 % to become as low as 7%. The mean of incidence of under-five mortality from the pooled data is 9 %.

Table 2: Total Children sampled Incidence of Under-five Mortality in 2000, 2005, and 2011

	Mean	St.dev	Sample Size
2000	0.11	0.31	10143
2005	0.09	0.28	9861
2011	0.07	0.26	11654
Total	0.09	0.28	31658

3.3.1 Yearly Characteristics of observations

Table 3 below summarizes characteristics of respondents for different years of the survey. The first two rows show means of maternal education levels. The mean years of maternal schooling are 1.28 years, 1.18 years, and 1.58 years for 2000, 2005, and 2011 respectively. The mean years of schooling has decreased in 2005. The reason can be the inclusion of more remote and rural areas in the 2005 survey than in the 2005 survey. In the same table below, it is reported that the sample from rural areas has increased from 77% to 86% from 2000 to 2005. But, in the last round of the survey, 2011, the mean maternal years of schooling has increased to 1.53 years.

The percentage of mothers with some education level (1 year of schooling and above) has increased from the year 2000 to 2011. In 2000, only 21% were educated. The proportion of educated mothers has increased to 23% in 2005, and 30% in 2011.

On the other hand, there is more proportion of women household heads in 2000 than 2005 with 23% and 14% of women being the household heads, respectively. But, it has increased to 34% in 2011. Age of the household head has consistently decreased from 2000 to 2011. In all the three rounds of the survey, 49% of the children are female.

There is improvement in paternal education. The proportion of fathers with no education was 64% in 2000 and has decreased to 60% in 2005 and 52% in 2011. Mean household size of the sam-

pled families has increased. The other important variable presented is mothers' status of working. The proportion of mothers who are participating in paid work are higher in 2000 than 2005 and 2011.

The sample characteristics from 2000 is better than the sample in 2005 in many aspects. These include; visiting health facility in one year ahead of the survey, the type of floor material and sanitation used. On the opposite side, in terms of use of family planning service and contraceptive use, sample from 2005 is better than 2000. But, in all these variables, there is improvement in 2011 survey.

Access to information was seen through ownership of media sources, radio and television, and use of them. The proportion of children under the age of five in households owning radio and television and proportion of children where their households listen radio and watch television is higher in 2011 than in 2005. But, this information is missing for 2000.

Table 3: Summary of sample characteristics by year

Variables	2000		2005		2011	
	Mean	Std. Dev.	Mean	Std. Dev	Mean	Std. Dev
Mother education level in single years	1.28	3.01	1.18	2.78	1.53	3.09
Mothers' education level in groups						
No education	0.79	0.41	0.77	0.42	0.70	0.46
Primary education	0.13	0.33	0.16	0.36	0.25	0.43
Secondary education	0.08	0.27	0.06	0.25	0.03	0.18
Higher than secondary education	0.01	0.09	0.01	0.08	0.02	0.13
Sex of household head (1=female)	0.23	0.42	0.14	0.34	0.19	0.39
Age of the household head	41.46	12.24	38.13	11.56	37.72	12.07
Sex of the child (1=female)	0.49	0.50	0.49	0.50	0.49	0.50
Mother BMI	2019	372	2034.6	330.9	2034.3	357.4
Current age of the mother	32.38	8.55	29.01	6.95	29.04	6.63
Floor material (1=improved)	0.17	0.37	0.11	0.31	0.15	0.36
Sanitation (1=improved)	0.24	0.43	0.22	0.41	0.16	0.37
Source of drinking water (1=improved)	0.32	0.47	0.42	0.49	0.51	0.50
Electricity	0.19	0.39	0.13	0.34	0.18	0.38
Husband occupation	0.99	0.11	0.99	0.08	0.99	0.11
Wealth index (scale from 1 to 5)	-	-	2.87	1.47	2.73	1.50
Husband/partner education Groups						
No education	0.64	0.48	0.60	0.49	0.52	0.50
Primary education	0.19	0.40	0.26	0.44	0.37	0.48
Secondary education	0.13	0.34	0.12	0.33	0.07	0.26
Higher than secondary education	0.03	0.17	0.02	0.14	0.04	0.20
Household size	5.74	2.42	6.06	2.20	6.13	2.43
Mother working a paid work (1=working)	0.59	0.49	0.23	0.42	0.30	0.46
Visit health facility in last 12 months	0.47	0.50	0.10	0.29	0.40	0.49
Visit family planning service in the last 12 months	0.03	0.16	0.08	0.27	0.19	0.39
Health insurance	-	-	-	-	0.005	0.071
Contraceptive use (1=uses)	0.10	0.31	0.14	0.35	0.21	0.41
Religion						
Orthodox	0.46	0.50	0.40	0.49	0.31	.46
Catholic	0.01	0.09	0.01	0.10	0.19	0.39
Protestant	0.13	0.34	0.18	0.38	0.19	0.39
Muslim	0.36	0.48	0.39	0.49	0.47	0.50
Traditional	0.03	0.18	0.02	0.12	0.01	0.09
Others	0.002	0.04	0.01	0.10	0.01	0.11
Beating is justified if wife leaves to her parents' home without telling husband/partner	0.55	0.50	0.67	0.47	0.53	0.50
polygamy	0.14	0.35	0.12	0.33	0.14	0.35

Variables	2000		2005		2011	
	Mean	Std. Dev.	Mean	Std. Dev	Mean	Std. Dev
Have say on decision to use contraception	0.93	0.25	0.94	0.24	0.96	0.20
Have say on spending decision	0.96	0.20	0.90	0.30	0.88	0.32
Breastfeeding (1=more than six months)	0.87	0.33	0.84	0.37	0.90	0.30
Age of the mother at first birth	18.82	3.64	18.64	3.62	18.94	3.70
Child has twin	0.01	0.12	0.02	0.13	0.03	0.17
Pre-birth interval in months	39.58	23.62	37.52	20.42	37.58	20.79
Pre birth interval						
Less than two years	0.19	0.39	0.18	0.38	0.21	0.40
2 years to four years	0.45	0.50	0.46	0.50	0.43	0.50
Greater than four years	0.36	0.48	0.36	0.48	0.36	0.48
Total number of children born from the same mother	4.36	2.79	4.37	2.62	4.30	2.58
Wanted pregnancy	0.81	0.39	0.86	0.34	0.93	0.25
Mother listens radio	-	-	0.35	0.48	0.43	0.50
Mother watches television	-	-	0.12	0.32	0.30	0.46
Mother reads newspapers/magazine	-	-	0.08	0.27	0.08	0.27
Distance to health facility (1=big problem)	-	-	0.70	0.46	0.74	0.44
Rural (=1)	0.77	0.42	0.86	0.34	0.83	0.38
Place of delivery (1=health facility)	0.11	0.32	0.12	0.32	0.15	0.35
Antenatal visit during pregnancy (1=yes)	0.32	0.47	0.33	0.47	0.45	0.50
Size of child at birth (SCALE-0 to 5, where 0 is bigger?)	3.09	1.05	2.97	1.36	3.08	1.36
Size of the child at birth	0.64	0.48	0.72	0.45	0.69	0.46
Household has television	0.05	0.23	0.05	0.23	0.10	0.30
Household has radio	-	-	0.36	0.48	0.37	0.48
Household has refrigerator	-	-	0.03	0.17	0.10	0.30

Generally, the characteristics summarized and discussed above showed that there is a decrease in the mean of incidence of under-five mortality overtime. On the other hand, there was overtime improvement in the means of education level, access to information, and in many of the other characteristics.

3.3.2 Incidence of under-five mortality by region

Regional incidence of mortality is summarized in Table 4 below. In 2000, the mean of incidence of under-five mortality was 11%. There was regional variation where the mean incidence was very high in Afar and Gambella with 17% and 14% respectively. Whereas, it was 8% in Addis Ababa, Tigray and Somali Regional States of Ethiopia. In 2005, the highest mean of incidence of mortality was 12 % in Amhara Region and the lowest was 5% in Addis Ababa. Whereas, in 2011 the highest mean of under-five mortality was 9% in Benishangul Gumz with 9% and the lowest was in Addis Ababa with 4%. Generally, percentage of children dying below the age of five has decreased in every region in Ethiopia between the years 2000 to 2011.

Table 4: Incidence of under-five mortality by region

Region	2000		2005		2011	
	Obs=10143		Obs=9861		Obs=11654	
	Mean	Std. Dev	Mean	Std. Dev.	Mean	Std. Dev.
Tigray	0.09	0.28	0.07	0.25	0.07	0.25
Afar	0.17	0.37	0.09	0.29	0.09	0.28
Amhara	0.11	0.31	0.12	0.32	0.07	0.26
Oromia	0.11	0.31	0.09	0.28	0.07	0.26
Somali	0.08	0.27	0.09	0.28	0.07	0.26
Benishangul-Gumz	0.10	0.31	0.09	0.29	0.09	0.29
SNNP	0.11	0.32	0.09	0.29	0.08	0.27
Gambella	0.14	0.35	0.07	0.25	0.08	0.27
Harari	0.11	0.31	0.06	0.24	0.07	0.25
Addis Ababa	0.08	0.27	0.05	0.22	0.04	0.18
Dire Dawa	0.13	0.33	0.08	0.26	0.05	0.22
Total	0.11	0.31	0.09	0.28	0.07	0.26

3.3.3 Characteristics of respondents by incidence of mortality

This sub-section summarizes the characteristics of the children, their mothers, and families based on differences in under-five mortality status. It shows child, maternal and household characteristics between the children alive and the children died below the age of five. Here again, the summary is presented for the years 2000, 2005 and 2011 differently and is shown in Table 5 below.

From the table, we see that mean of years of maternal schooling for mothers' whose children are alive is higher than mean of years of schooling of children whose children died. T-test results for all the years 2000, 2005 and 2011 show a significantly higher mean of years of schooling for mothers with their children alive than mothers whom their children has died. The mean differences are statistically significant at 1% with t-values of 5.97, 4.70, and 4.08 for 2000, 2005 and 2011, respectively. Similarly, the proportion of mothers with no education is higher for those whose children sampled have died. The highest proportion of fathers' whom their children are alive have at least one year of education. This consistency in having higher maternal and paternal education for families of children alive can be a good motivator in looking at the contribution education has to under-five mortality using regressions.

As we saw above, mean age of the household head decreases overtime. In addition, from Table 5 below we see that the mean age of household heads is lower in families where the sampled children are alive for all three periods.

On the other hand, proportion of improved floor materials, better sanitation services, better source of drinking water, and access to electricity is higher for the children alive. Wealth index data is available only for the years 2005 and 2011. In both of these periods, the mean of wealth scale is higher for the families where the alive children are sampled from. The mean differences on the

wealth index is statistically significant at 1% level of significance with t-values of 2.88 and 3.55 for 2005 and 2011 respectively.

The mean size of the households for children alive is higher than mean size of households with children died under the age of five. The mean difference is statistically significant for 2000, 2005 and 2011 with t-values of 14.33, 11.26, and 9.06 respectively. On the other hand, for all the three periods, a little lower proportion of mothers with alive children are participating in paid work.

More proportion of mothers' of the alive children have visited a health facility at least once in a year ahead of the corresponding survey. The highest proportion of these mothers have also used contraception than the mothers of the children died. Similarly, more proportion of mothers whose sampled children are alive have made antenatal visit and more proportion of them have delivered their children in health facilities. With variables related to women empowerment like having say on decision to use contraception, having say on spending decision, and polygamy, mothers with alive children are better off.

Mean of months of pre-birth interval is significantly higher for the mothers with alive under-five aged children, for all the three periods. The mean differences are statistically significant ($p<0.01$) with t-values of 6.4050, 8.5901 and 7.1724 for the years 2000, 2005, and 2011 respectively.

The percentage of children with families' access to information is higher for the children alive than families of the children who died below the age of five. Distance to health facility is also a biggest problem for families of the children died.

Table 5: Characteristics of respondents based on incidence of mortality

variables	2000				2005				2011			
	Incidence of under-five mortality				Incidence of under-five mortality				Incidence of under-five mortality			
	Alive		Not-alive		Alive		Not-alive		Alive		Not-alive	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Mother education in years	1.34	3.08	0.77	2.27	1.22	2.83	0.76	2.08	1.22	2.83	0.76	2.08
Mother education (0=no education)	0.22	0.41	0.15	0.35	0.23	0.42	0.17	0.37	0.23	0.42	0.17	0.37
Husband education level	0.37	0.48	0.29	0.45	0.41	0.49	0.33	0.47	0.41	0.49	0.33	0.47
Sex of household head (1=female)	0.22	0.41	0.29	0.45	0.13	0.34	0.14	0.35	0.13	0.34	0.14	0.35
Age of the household head	41.22	12.15	43.42	12.76	38.10	11.48	38.40	12.39	38.10	11.48	38.40	12.39
Sex of the child (1=female)	0.49	0.50	0.48	0.50	0.50	0.50	0.43	0.50	0.50	0.50	0.43	0.50
Mother BMI	2021.78	382.07	1996.38	275.48	2035.57	336.46	2024.91	270.21	2035.57	336.46	2024.91	270.21
Current age of the mother	32.08	8.43	34.85	9.10	29.02	6.89	28.96	7.55	29.02	6.89	28.96	7.55
Floor material (1=improved)	0.17	0.38	0.13	0.33	0.89	0.31	0.95	0.23	0.89	0.31	0.95	0.23
Sanitation (1=improved)	0.24	0.43	0.22	0.42	0.78	0.41	0.78	0.42	0.78	0.41	0.78	0.42
Source of drinking water (1=improved)	0.33	0.47	0.29	0.46	0.58	0.49	0.54	0.50	0.58	0.49	0.54	0.50
Electricity	0.20	0.40	0.16	0.36	0.14	0.34	0.09	0.28	0.14	0.34	0.09	0.28
Husband occupation	0.99	0.11	0.98	0.13	0.99	0.08	0.99	0.08	0.99	0.08	0.99	0.08
Wealth index (a scale from 1 to 5, where 5 is the richest)	-	-	-	-	2.88	0.016	2.73	0.046	2.74	0.015	2.55	0.051
Household size	5.86	2.40	4.77	2.40	6.14	2.17	5.26	2.28	6.14	2.17	5.26	2.28
Mother working a paid work (1=working)	0.58	0.49	0.61	0.49	0.23	0.42	0.26	0.44	0.23	0.42	0.26	0.44
Visit health facility in last 12 months	0.48	0.50	0.39	0.49	0.10	0.30	0.07	0.26	0.10	0.30	0.07	0.26
Health insurance	-	-	-	-	-	-	-	-	.0051	.071	0.005	.069
Contraceptive use	0.11	0.31	0.08	0.27	0.15	0.35	0.09	0.29	0.15	0.35	0.09	0.29
Beating is justified if wife leaves to her parents' home without telling husband/partner	0.55	0.50	0.56	0.50	0.67	0.47	0.67	0.47	0.67	0.47	0.67	0.47

variables	2000				2005				2011			
	Incidence of under-five mortality				Incidence of under-five mortality				Incidence of under-five mortality			
	Alive		Not-alive		Alive		Not-alive		Alive		Not-alive	
Breast feeding	0.88	0.33	0.81	0.39	0.86	0.34	0.59	0.49	0.89	0.31	1.00	0.00
Have say on decision to use contraception	0.93	0.25	0.90	0.30	0.94	0.24	0.94	0.23	0.94	0.24	0.94	0.23
Have say on spending decision	0.95	0.21	0.97	0.18	0.91	0.29	0.88	0.33	0.91	0.29	0.88	0.33
polygamy	0.14	0.35	0.17	0.38	0.12	0.32	0.16	0.36	0.12	0.32	0.16	0.36
Age of the mother at first birth	18.81	3.60	18.90	3.92	18.65	3.62	18.53	3.68	18.65	3.62	18.53	3.68
Child has twin	0.01	0.10	0.05	0.22	0.01	0.12	0.05	0.22	0.01	0.12	0.05	0.22
Pre-birth interval in months	40.15	23.88	34.79	20.65	38.11	20.52	30.98	18.02	30.98	18.02	30.98	18.02
Visit family planning service in the last 12 months	0.03	0.16	0.11	0.31	0.08	0.27	0.06	0.23	0.08	0.27	0.06	0.23
Total number of children born from the same mother	4.32	2.76	4.64	3.04	4.33	2.61	4.72	2.77	4.33	2.61	4.72	2.77
Wanted pregnancy	0.81	0.39	0.77	0.42	0.86	0.35	0.87	0.34	0.86	0.35	0.87	0.34
Mother listens radio	-	-	-	-	0.35	0.48	0.32	0.47	0.43	0.50	0.43	0.49
Mother watches television	-	-	-	-	0.12	0.33	0.09	0.28	0.30	0.46	0.27	0.44
Mother reads newspapers/magazine	-	-	-	-	0.08	0.27	0.06	0.23	0.08	0.27	0.06	0.24
Distance to health facility (1=big problem)	-	-	-	-	0.70	0.46	0.72	0.45	0.74	0.44	0.77	0.42
rural (=1)	0.77	0.42	0.79	0.41	0.86	0.35	0.90	0.30	0.86	0.35	0.90	0.30
Place of delivery (1=health facility)	0.11	0.32	0.11	0.31	0.12	0.32	0.08	0.28	0.12	0.32	0.08	0.28
Antenatal visit during pregnancy	0.32	0.47	0.28	0.45	0.33	0.47	0.25	0.43	0.33	0.47	0.25	0.43
Size of child at birth (SCALE-0 to 5, where 0 is bigger?)	3.11	1.04	2.97	1.15	2.98	1.35	2.92	1.49	2.98	1.35	2.92	1.49
Size of the child at birth	0.64	0.48	0.68	0.47	0.72	0.45	0.71	0.45	0.72	0.45	0.71	0.45
Household has television	0.06	0.23	0.03	0.16	0.36	0.48	0.31	0.46	0.36	0.48	0.31	0.46
Household has radio	-	-	-	-	0.36	0.48	0.31	0.36	0.37	0.48	0.34	0.48
Household has refrigerator	-	-	-	-	0.03	0.18	0.01	0.11	0.10	0.30	0.08	0.27

3.3.4 Summary characteristics by groups of maternal education level

As seen in the Table 3 before, the mean years of schooling is 1.28 years, 1.18 years and 1.53 years for 2000, 2005 and 2011 respectively. From the same table we have seen that the proportion of mothers with no education has decreased overtime. On the other hand, proportion of mothers with primary education levels have increased over time. Oppositely, the proportion of mothers with secondary and above secondary education has decreased overtime. It may have happened as the survey goes on including farthest areas of the country where such people are scarce, as justified by the increment in the ratio of rural people included in the sample. But, due to the special attention given by the Ethiopian government to providing primary education to remote rural areas, access to primary education could go on increasing despite the difference in geographical location. Having this foundation, this section summarized characteristics of observation by different groups of maternal education. Table 6 summarizes the child, maternal and household characteristics based on different categories of maternal education for the years 2000, 2005 and 2011.

Though years of schooling is used in the LPM regressions, in this sub-section we used categories of maternal education to see the characteristics of observations. Discussing child, maternal, and household characteristics at different levels of education helped us to understand the effect maternal education will have on variables identified as channels. It helps to see if there are differences in characteristics of children, mothers, and their families for different levels of maternal education. This discussion gives preliminary information on which factors will be associated with maternal education and will therefore mediate the effect maternal education has on under-five mortality.

The percentage of incidence of under-five mortality is lower for families with better educated mothers. In 2000, the incidence of under-five mortality was 12% for children whose mothers do not have formal education. But, for children of educated mothers have a lower incidence of under-five mortality. In both 2005 and 2011, incidence of mortality was 9%, 7%, 5%, and 1% for children whom their mothers have no formal education, only primary education, secondary education, and above secondary education respectively. In means of age of the household head and current age of the mother, there was no clear difference between mothers having different education levels.

In addition to wealth index variable, the type of floor materials used, the status of sanitation services, the source of drinking water, and access to electricity power are the variables used to show the socio-economic status of the families. The results in Table 6 below showed that families where mothers are better educated have higher percentage of any of these family status indicators. The same information can be inferred from wealth index. For the years 2005 and 2011, the mean wealth index is higher for households where mothers have higher years of schooling.

Table 6: Summary of characteristics based on different education levels.

variables	2000				2005				2011			
	Education level				Education level				Education level			
	0	1^0	2^0	$>2^0$	0	1^0	2^0	$>2^0$	0	1^0	2^0	$>2^0$
Child is not-alive (1=not-alive)	0.12	0.09	0.05	0.07	0.09	0.07	0.05	0.01	0.08	0.07	0.04	0.03
Sex of household head (1=female)	0.21	0.26	0.36	0.28	0.12	0.15	0.27	0.27	0.17	0.20	0.31	0.31
Age of the household head	41.89	39.49	40.31	40.81	38.53	36.39	37.46	38.94	38.26	36.33	37.41	36.92
Sex of the child (1=female)	0.49	0.50	0.49	0.46	0.49	0.48	0.52	0.54	0.49	0.48	0.45	0.57
Mother BMI	1986.3	2074.2	2217.9	2392.2	2018.9	2019.8	2218.3	2494	2006.3	2057.4	2316.9	2308
Current age of the mother	33.15	29.24	29.48	34.30	29.56	26.93	27.28	31.32	29.86	27.08	27.01	28.32
Floor material (1=improved)	0.09	0.31	0.66	0.80	0.04	0.14	0.69	0.82	0.09	0.24	0.69	0.84
Sanitation (1=improved)	0.15	0.45	0.79	0.89	0.19	0.33	0.30	0.27	0.11	0.21	0.60	0.65
Source of drinking water (1=improved)	0.23	0.51	0.86	0.88	0.54	0.64	0.88	0.96	0.45	0.60	0.90	0.89
Electricity	0.09	0.40	0.82	0.84	0.06	0.06	0.77	0.89	0.11	0.27	0.78	0.82
Husband has occupation (1=Yes)	0.99	0.97	0.98	1.00	0.99	0.99	0.99	1.00	0.99	0.99	0.99	1.00
Husband education level (0=no education)	0.24	0.75	0.95	1.00	0.29	0.73	0.96	1.00	0.35	0.76	0.98	0.99
Wealth index (scale of 1 to 5, where 5 represents the richest)	-	-	-	-	2.56	3.52	4.75	4.96	2.40	3.26	4.56	4.92
Household size	5.78	5.61	5.56	5.45	6.15	5.86	5.54	6.07	6.30	5.86	5.06	4.82
Mother working a paid work (1=working)	0.59	0.55	0.55	0.89	0.22	0.23	0.33	0.65	0.27	0.35	0.35	0.76
Visit health facility in last 12 months	0.42	0.60	0.70	0.73	0.04	0.14	0.53	0.84	0.34	0.51	0.71	0.73
Antenatal visit during pregnancy	0.23	0.54	0.83	0.90	0.23	0.46	0.85	0.98	0.34	0.60	0.92	0.93
Visit family planning service in the last 12 months	0.02	0.05	0.04	0.01	0.07	0.11	0.13	0.01	0.17	0.22	0.23	0.23
Contraceptive use	0.05	0.22	0.43	0.60	0.09	0.21	0.54	0.72	0.15	0.31	0.53	0.65
Beating is justified if wife leaves to her parents' home without telling husband/partner	0.61	0.46	0.21	0.10	0.70	0.62	0.39	0.20	0.58	0.45	0.18	0.88

variables	2000				2005				2011			
	Education level				Education level				Education level			
	0	1^0	2^0	$>2^0$	0	1^0	2^0	$>2^0$	0	1^0	2^0	$>2^0$
polygamy	0.16	0.10	0.04	0.03	0.13	0.11	0.03	0.01	0.16	0.11	0.04	0.02
Have say on decision to use contraception	0.90	0.95	0.95	0.98	0.92	0.97	0.96	0.96	0.96	0.96	0.97	1.00
Have say on spending decision	0.95	0.97	0.97	0.98	0.89	0.87	0.95	1.00	0.87	0.90	0.95	0.97
Brest feeding	0.88	0.87	0.83	0.83	0.84	0.84	0.83	0.69	0.91	0.89	0.87	0.90
Age of the mother at first birth	18.69	18.62	19.95	23.31	18.52	18.19	20.60	23.82	18.77	18.77	21.47	23.28
Child has twin	0.01	0.02	0.01	0.01	0.02	0.01	0.02	0.03	0.03	0.02	0.05	0.03
Pre-birth interval in months	38.68	40.34	49.38	48.78	36.56	38.15	49.52	58.83	36.16	40.30	53.68	56.60
Total number of children born from the same mother	4.74	3.23	2.51	2.38	4.67	3.74	2.48	2.61	4.77	3.47	2.12	1.81
Wanted pregnancy	0.83	0.77	0.72	0.90	0.87	0.84	0.83	0.93	0.93	0.92	0.95	0.95
Distance to health facility (1=big problem)					0.76	0.64	0.30	0.21	0.80	0.67	0.35	0.31
rural (=1)	0.88	0.54	0.11	0.15	0.94	0.81	0.18	0.07	0.91	0.75	0.19	0.17
Place of delivery (1=health facility)	0.04	0.22	0.64	0.90	0.05	0.16	0.65	0.93	0.07	0.22	0.74	0.86
Size of the child at birth	0.62	0.71	0.79	0.88	0.71	0.75	0.81	0.82	0.67	0.72	0.75	0.80
Size of the child at birth SCALE	3.13	3.00	2.92	2.61	3.01	2.92	2.72	2.87	3.13	2.98	2.95	2.82
Household has television	0.01	0.10	0.32	0.62	0.29	0.48	0.85	0.94	0.04	0.15	0.61	0.71
Household has radio	-	-	-	-	0.29	0.48	0.86	0.94	0.32	0.45	0.67	0.77
Type of floor material (1=improved)	0.09	0.31	0.66	0.80	0.04	0.14	0.69	0.82	0.09	0.23	0.69	0.84
Sanitation (1-improved)	0.15	0.45	0.79	0.89	0.81	0.67	0.71	0.73	0.11	0.21	0.60	0.65
Source of drinking water (1=improved)	0.23	0.51	0.86	0.88	0.54	0.64	0.88	0.96	0.45	0.60	0.90	0.89

Standard deviations are not reported because the table reported many categories of education for three time periods, and reporting them would make the table bulky.

Chapter 4
Results and Discussion

In this chapter, the results for determinants of under-five mortality are presented for the years 2000, 2005, 2011 and the pooled dataset. The results presented in this were discussed giving greater emphasis to maternal education. Then, the pathways through which maternal education affect under-five mortality are identified and discussed.

4.1 Determinants of Under-five Mortality

In this section, Linear Probability Model (LPM) regressions were estimated to determine the factors that affect under-five mortality in Ethiopia. Separate LPM regressions were estimated for each of the years 2000, 2005, and 2011, and for the pooled data set. There are some variables missing in the data for 2000. It happened because the EDHS data kept on being improved and there are some variables which can be found only in the later rounds of the survey. Therefore, regression on 2000 EDHS data and the pooled data set have missed some variables and the estimations may not be as efficient as the 2005 and 2011 regressions. Despite the missing variables, the data 2000 and the pooled dataset have the most important variables needed and the discussion below is based on the result from these datasets and summarized in Table 7 below.

The main variable of interest in this study is maternal education. The estimates show that increasing years of maternal education reduces the probability of under-five mortality. But, the magnitude of coefficients are small and they are significant for only 2011 ($p<0.01$) and the pooled dataset ($p<0.05$). In 2011, the probability that a child will die before reaching its fifth birthday decreases by 0.32 percentage points for additional year of maternal schooling.

Table 7: LPM estimates of under-five mortality in Ethiopia from the year 2000 to 2011

VARIABLES	(1) 2000	(2) 2005	(3) 2011	(4) Total
Mother education level in single years	-0.0023	-0.0021	-0.0032***	-0.0017**
	(0.0015)	(0.0014)	(0.0011)	(0.0008)
Sex of household head (1=female)	0.011	-0.00089	-0.0070	-0.0003
	(0.0089)	(0.0086)	(0.0067)	(0.0050)
Sex of the child (1=female)	-0.0058	-0.0215***	-0.0091*	-0.012***
	(0.0061)	(0.0056)	(0.0048)	(0.0035)
Age of the household head	0.0021***	0.0018***	0.0008***	0.0015***
	(0.00033)	(0.00033)	(0.00024)	(0.00018)
Age of the mother (reference age:15-19 years)				
Current age of the mother (20-34)	-0.0008	-0.0334***	-0.050***	-0.028***
	(0.0093)	(0.0093)	(0.008)	(0.0053)
Current age of the mother (>=35)	0.0348**	-0.076***	-0.051***	-0.017**
	(0.0142)	(0.015)	(0.013)	(0.009)
Mothers' Body Mass Index (BMI)	-	-	2.03e-05**	-
	-	-	(9.63e-06)	-
Mothers' height in centimeters	-0.00012***	-	-0.00014***	-2.84e-06*
	(4.49e-05)	-	(3.96e-05)	(1.59e-06)
Floor material (1=improved)	-0.0026	-0.0095	0.0167*	0.015***
	(0.0115)	(0.012)	(0.0099)	(0.0052)
Source of drinking water (1=improved)	0.00072	0.0095	-0.0022	-0.0026
	(0.0092)	(0.0062)	(0.0057)	(0.0041)
Sanitation (1=improved)	0.012	0.0063	-0.0124*	-0.0017
	(0.011)	(0.008)	(0.0074)	(0.0051)
Electricity access (1=Yes)	-0.027	0.0009	0.007	-0.0065
	(0.0185)	(0.015)	(0.011)	(0.008)
Husband (partner) is employed	-0.0396	0.018	0.028	-0.0013
	(0.033)	(0.030)	(0.019)	(0.017)
Wealth index (reference group: poorest)				
Poorer	-	0.0055	0.0026	-
		(0.0092)	(0.0078)	
Middle	-	0.014	0.0021	-
		(0.0099)	(0.0083)	
Richer	-	0.0078	-0.0074	-
		(0.010)	(0.0087)	
Richest	-	-0.012	-0.0026	-
		(0.012)	(0.014)	
Paternal education in groups (reference: No-education)				
Primary education	-0.0066	-0.011	-0.0023	-0.0049
	(0.0085)	(0.0072)	(0.0058)	(0.0043)
Secondary education	-0.0142	-0.021**	-0.00082	-0.0097
	(0.012)	(0.011)	(0.0103)	(0.0071)
Above secondary level of education	-0.041**	-0.041**	0.007	-0.017
	(0.019)	(0.016)	(0.014)	(0.0105)
Household size	-0.025***	-0.030***	-0.018***	-0.024***
	(0.0018)	(0.0022)	(0.0016)	(0.0011)
Mother participating in a paid work (1=Yes)	0.0085	0.019***	0.0031	0.0084**
	(0.0066)	(0.0071)	(0.0056)	(0.0039)
The mother visited health facility in last 12 months	-0.021***	0.015	-0.00111	-0.011***
	(0.0064)	(0.012)	(0.0052)	(0.0039)
The family has health insurance			0.012	
			(0.033)	
The mother uses modern contraceptive method	0.0049	-0.0199**	-0.038***	-0.0203***
	(0.011)	(0.0085)	(0.0062)	(0.00487)
Religion (reference: Orthodox)				
Catholic	-0.0073	-0.019	0.034	0.016

VARIABLES	(1) 2000	(2) 2005	(3) 2011	(4) Total
	(0.036)	(0.028)	(0.032)	(0.021)
Protestant	-0.0046	-0.0014	-0.0060	-0.0084
	(0.012)	(0.010)	(0.00989)	(0.0067)
Muslim	0.020**	-0.0055	-0.0053	0.0060
	(0.0093)	(0.0085)	(0.0081)	(0.0055)
Traditional	-0.015	-0.042**	0.005	-0.012
	(0.019)	(0.019)	(0.032)	(0.015)
Beating is justified if wife leaves to her parents' home without telling husband/partner	0.0044	0.0077	-0.005	-0.0012
	(0.0066)	(0.006)	(0.0051)	(0.0037)
Breast feeding (breast feeding for more 6 months – reference: less than six months of breast feeding)			0.071***	
			(0.0035)	
Age of the mother at first birth	-0.00035	0.0021**	0.001	7.48e-05
	(0.0011)	(0.0011)	(0.0009)	(0.000628)
Child has twin (1=Yes)	0.283***	0.158***	0.198***	0.221***
	(0.0399)	(0.032)	(0.024)	(0.019)
Size of child at birth (1=large) –reference is small		0.0035	0.016***	
		(0.0063)	(0.0052)	
Total number of children born from the same mother	0.0050**	0.0376***	0.026***	0.012***
	(0.0022)	(0.0035)	(0.003)	(0.00134)
Parity (birth order number) – reference is first				
Second and third		-0.053***	-0.022**	
		(0.0100)	(0.0085)	
Fourth and fifth		-0.078***	-0.044***	
		(0.014)	(0.013)	
Six and greater		-0.123***	-0.092***	
		(0.021)	(0.019)	
Wanted pregnancy (1=Yes)		0.0086	0.012	
		(0.0085)	(0.0095)	
Mother listens radio		0.0149**	0.0123**	
		(0.0070)	(0.00563)	
Mother watches television		0.0047	0.00164	
		(0.0123)	(0.00676)	
Mother reads newspapers/magazine		0.0128	0.0129	
		(0.0120)	(0.0114)	
Distance to health facility (1=big problem)		0.00058	0.0040	
		(0.0068)	(0.0061)	
Regional Dummies (13 regional dummies included)				
Rural (=1)	-0.0315**	-0.0126	-0.011	-0.020***
	(0.0158)	(0.0144)	(0.011)	(0.0078)
Time (reference :2000)				
2005				-0.020***
				(0.007)
2011				-0.019***
				(0.004)
Constant	0.384***	0.0932**	0.154**	0.160***
	(0.0838)	(0.0469)	(0.073)	(0.0251)
Number of Observations	9,765	9,532	10,975	25,829
R-squared	0.063	0.058	0.062	0.050

- Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
- The regressions in the above table have controlled for regional difference (13 regional dummies, rural(=1), and distance to health facility)
- The full table which includes coefficients for regional dummies is available on Appendix 1, at the end of the document.

The above discussion on maternal education coefficient was based on the estimate on years of schooling. Here we have seen the effect of a change in maternal education from one category to another category of education. This was done to see if a big change in maternal education (between categories of education) could have effect on incidence of under-five mortality.

In 2000, a children from a mother with secondary level of education is 3.42 percentage points less likely to die under the age of five when compared to children born from mothers with no education level ($p<0.05$). But, a change of maternal education from no-education level to primary education and above secondary level do not bring a significant difference in the probability of occurrence of under-five mortality. Similarly, in 2005, a change in maternal education from no-education level to any other education level (primary, secondary, and above secondary) do not bring a significant difference in the probability of under-five mortality. On the other hand, in 2011, a change in maternal education from no-education to secondary and above secondary education levels bring significant ($p<0.05$) decreases in the probability of under-five mortality. But, the change to primary education level did not bring significant effect on the probability of incidence of under-five mortality. Table 8 below summarizes the coefficients for different groups of maternal education from LPM regressions with the same set of variables used to produce results in Table 7 above.

Table 8: Coefficients for LPM estimates of under-five mortality on groups of maternal education

Variables	(1)	(2)	(3)	(4)
	2000	2005	2011	Total
Maternal Education level (reference: No education)				
Primary education	-0.0118	-0.0126	0.000853	0.000455
	(0.0102)	(0.00844)	(0.00646)	(0.00491)
Secondary education	-0.0342**	-0.0202	-0.0349**	-0.0224**
	(0.0147)	(0.0139)	(0.0138)	(0.00868)
Above secondary	0.00461	-0.0304	-0.0508***	-0.0305**
	(0.0325)	(0.0209)	(0.0187)	(0.0136)

Notes: - Robust standard errors are given in parentheses; *** p<0.01, ** p<0.05, * p<0.1

- These estimates are found using the same covariates used in Table 7. The only difference between the two Tables is the change in the measurement of maternal education.

The result in the table above shows the same story we obtained from using years of maternal schooling. Except secondary education is decreases the probability of under-five mortality in 2000, both cases show that formal maternal education is not a very big determinant of under-five mortality in 2000 and 2005., But, it is a significant determinant of under-five mortality in 2011, mainly secondary and above secondary levels of maternal education. The results on 2000 and 2005 are opposite to the findings of many studies that reported a significant effect of maternal education on different health indicators (Dejene and Girma 2013, Mekonnen 2011, Mekonnen et al. 2013). This can be due to the inclusion of many covariates of maternal education in this study. As the main objective of this study is to find the effect of maternal education on under-five morality, it tried to control for many sources of bias on maternal education's coefficient. For example, it has controlled for many variables of attitude towards health care service utilization, maternal employment status, and reproductive behaviors of mothers. It may cause a significant decrease in the coefficient and it becomes much closer to the true effect.

There are other statistically significant determinants of under-five mortality which are reported in the above table. Age of the household head, age of the mother (greater than thirty five years),

household size, a child having twin, total number of children born from the same mother, birth order, and mothers' listening to radio are the factors that consistently and significantly determine under-five mortality in 2000, 2005, 20011 and the poled dataset. Other factors like sex of the child, age of the mother (20 to 34 years), maternal nutritional status, above secondary level of education, and visiting health facility significantly determine under-five mortality at least in one of the four LPM estimates reported in Table 7.

Regional dummies, area of residence (rural), and distance to health facility are the variables entered in regression mainly to control for endogeneity that may arise from geographical differences among the sampled children. At the same time, we can infer about the effect regional differences have on the probability of under-five mortality. In 2000, Children in Afar and Gambella have significantly higher probability of dying under the age of five compared to Addis Ababa. In this year, being in other regions had no significant effect on the probability of death of children under the age of five. In 2005, only children in Tigray have significantly different probability of dying under the age of five than Addis Ababa. Children in Tigray are 3.9 percentage points more likely to be alive than the children in Addis Ababa. For 2000 and 2005, being in Addis Ababa, which is the capital city of the country and may be advantageous in many health characteristics, did not create much difference in the probability of a children dying under the age of five. But in 2011, children in other regions of the country (except Dire Dawa) have significantly higher probability of dying under the age of five. Though the coefficient is negative for Dire Dawa and show that it has lower probability of occurrence of under-five mortality than Addis Ababa, it is not significant. This insignificant difference can happen because both are city administrations and can have similar characteristics in many household and health indicators.

4.2 Association of Maternal Education and Other Factors on their determination of Under-five Mortality

In the above section, we discussed the effects of different variables on under-five mortality. Maternal education was the main variable of interest and the coefficients for maternal education similar to those discussed above are reported in at the last columns of all the tables reported in this section. These coefficients are produced from regressions that controlled for many variables including all those investigated as pathways. Therefore, they show the direct effect of formal education on under-five mortality.

Maternal education can contribute to lower the probability of occurrence of under-five mortality either directly through the difference in knowledge created by the formal education mothers got or/and indirectly through other factors that have been affected by maternal education itself. In all the Tables 9, 10, 11 and 12 below, the first column results are LPM estimates found by regressing the occurrence of under-five mortality on years of maternal education and some control variables; regional dummies, area of residence (rural), distance to health facility, maternal nutritional height and body mass index, age of the mother, age of household head, sex of the child, and sex the household head. Then, pathways through which maternal education are expected to affect under-five mortality were introduced one by one. Those factors tested for their association with maternal education include, socio-economics factors, mothers' employment status, attitude of mothers towards healthcare service utilization, women autonomy, reproductive behaviors of mothers and exposure to media. Most of these channels are sets of more than one variable.

Our interest is to see the change in the magnitude and the significance of the coefficient for maternal education (from the first specification) when each of the pathways are added. Then, we can claim that the change in the significance and the magnitude of the coefficient is due to the inclusion of the pathway. In the last column of all the tables, all of the possible pathways are included. There-

fore, the change in the significance and magnitude of the coefficient on years of maternal schooling from the first column to the last column shows the effect maternal education has on under-five mortality through the combination of the all pathways considered in this study.

Estimates for 2000 which is reported in column 1 of Table 9 below show that years of maternal schooling have negative and significant effect on probability of occurrence of under-five mortality. This coefficient shows the sum of the direct and indirect effect of maternal education i.e., it is a total effect of maternal education. In column 2 of the same table, a group of socio-economic factors were introduced and the coefficient for maternal education has decreased and its level of significance also changed from 1% to 5%. The change in the coefficient for maternal education which mediated the effect of maternal education through socio economic factors is -0.00265 (=-0.00552+0.00287). This means almost 50% of the effect of maternal education is mediated through socio-economic factors. This is similar to the finding of Frost et al. (2005) whom also found socio-economic factors as a significant pathways for the effect of maternal education on child nutritional status in Bolivia.

On the other hand, the coefficient for maternal education did not change much due to the introduction of other possible pathways. Therefore, maternal employment status, attitude of mothers' towards healthcare service utilization, women autonomy, and reproductive behaviors of mothers do not mediate the effect of maternal education on under-five mortality.

The coefficient for maternal education in the last column is not significant and its magnitude is lower than the coefficient in the first column. The change in the magnitude shows the effect of maternal education through all the included pathways. The change in the significance level shows the mediation of the pathways is significant. The pathways in general have therefore accounted for around 60% of the effect of maternal education. Similarly, all the pathways included accounted 60% of the total effect of maternal education on child nutritional status in Bolivia (Frost et al. 2005). The rest (40%) can the direct effect of maternal education and the effect through factors that were not included in the regression (if significant variable is missed).

Table 9: Association between maternal education and different pathways in 2000

List of variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Maternal Education (in years)	-0.00552***	-0.00287**	-0.00559***	-0.00445***	-0.00553***	-0.00590***	-0.00225
	(0.00109)	(0.00144)	(0.00109)	(0.00115)	(0.00111)	(0.00111)	(0.00150)
Socio-economic factors		#					#
Maternal Employment status			#				#
Attitude of mothers' towards healthcare service utilization				#			#
Women autonomy					#		#
Reproductive behaviors of Women						#	#
Regional control dummies	#	#	#	#	#	#	#
Rural	#	#	#	#	#	#	#
Other control variables	#	#	#	#	#	#	#
Constant	0.334***	0.384***	0.332***	0.332***	0.330***	0.360***	0.384***
	(0.0733)	(0.0812)	(0.0734)	(0.0732)	(0.0735)	(0.0753)	(0.0838)
Number of observation	10,068	9,851	10,064	10,067	9,982	10,068	9,765

- Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
- Other control variables include: sex of the household head, age of the household head, age of the mother, mother height

In 2005, the total effect of maternal education on under-five mortality is given by its coefficient on column 1 in Table 10. This coefficient (0.00375) is lower than the total effect maternal education had in 2000 (i.e., 0.0052). In this case, both socio-economic factors and attitude of mothers towards health care service utilization are the significant pathways mediating the effect of maternal education on under-five mortality. In both cases the introduction of the factors have caused a fall in the absolute value of the coefficient for maternal education and the coefficients are no more significant. Socio-economic factors alone have mediated (0.00116 - 0.00375)/0.00375=69% and attitude of mothers to health care service utilization has mediated (0.00165 - 0.00375)/0.00375=56% of the total effect of maternal education. The effect of these two pathways exceeded 100% because these two variable sets are correlated. In these two pathways which are a set of variables, there are some variables which can correlate on their effect on under-five mortality. For example, husband education level in socio-economic factors is have correlation of 21% and 27% with use of health facility and contraception use which are included a pathway called attitude towards health care service utilization.

Use of health services is one of the variables included in the significant pathway called attitude to health care service mutilation. Maternal education may have contributed for the increase in awareness and promoted use of health services. Buor (2003) in the study of child survival has found significant relation of maternal education and use of health services. Therefore, such relation between maternal education and the components of the pathway can explain its significant mediation of the effect.

On the other hand, the introduction of pathways called maternal employment status and reproductive behaviors of women did not bring big changes in the magnitude and no change on the significance of the coefficient for maternal education. Therefore, these factors are not channels

through which maternal education can indirectly affect under-five mortality. But, the introduction of exposure to media has increased the coefficient for maternal education. It shows, in reverse to our premise, that exposure to media is affecting incidence of under-five mortality through maternal education. Before the introduction of exposure to media in the regression, one year increase in maternal education was associated with 0.375 percentage points decrease in probability of occurrence of under-five mortality. But. When exposure to media is introduced the decrease in probability due to one year additional schooling has increased to 0.475 percentage points. This means that the effect of maternal education becomes stronger when combined with better access to media (radio, television, and magazine). But, the change in the coefficient for maternal education was not significant.

All the pathways combined mediated (-0.00212+0.00375)/(-0.00375)=44.23% of the total effect of maternal education on under-five mortality. Like discussed above for 2000, for 2005 also maternal education had big effect through pathways.

Table 10: Association between maternal education level and different pathways in 2005

List of variables	(1)	(2)	(3)	(4)	(5)	6)	(7)
Maternal Education (in years)	-0.00375***	-0.00116	-0.00384***	-0.00165	-0.00395***	-0.00475***	-0.00212
(se)	(0.00107)	(0.00125)	(0.00107)	(0.00126)	(0.00106)	(0.00128)	(0.00141)
Socio-economic factors		#					#
Maternal Employment status			#				#
Attitude of mothers' towards healthcare service utilization				#			#
Reproductive behaviors of Women					#		#
Exposure to media						#	#
Regional control dummies	#	#	#	#	#	#	#
Rural	#	#	#	#	#	#	#
Other control variables	#	#	#	#	#	#	#
Constant	0.0841***	0.181***	0.0779***	0.134***	0.0260	0.0822***	0.0932**
(se)	(0.0192)	(0.0450)	(0.0190)	(0.0406)	(0.0283)	(0.0209)	(0.0469)
Number of observation	9,860	9,695	9,858	9,650	9,819	9,815	9,532

- Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
- Other control variables include: sex of the household head, age of the household head, age of the mother, mother height

In 2011, the total effect of maternal education on under-five mortality has decreased and is now lower than the effect it had in 2000 and 2005. But, the coefficient is still significant showing a continuing significant total effect of maternal education. This year's result is highly different to 2000 and 2005 in terms of the effect of maternal education through channels. This year the inclusion of pathways did not bring a big change in neither the magnitude nor the level of significance of coefficients of maternal education. The result in the last column of the Table 11 below show that even a combined effect of all the pathways did not bring a change in the neither the magnitude nor the significance of the coefficient for maternal education. Therefore, in 2011 maternal education have a significant direct effect on under-five mortality. But, it does not have indirect effect. It means; in 2011, maternal education is not associated with other factors tested for their mediation in its effect on under-five mortality.

Table 11: Association between maternal education and other pathways in 2011

List of variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Maternal Education (in years)	-0.00322*** (0.000821)	-0.00394*** (0.000998)	-0.00328*** (0.000826)	-0.00279*** (0.000858)	-0.00311*** (0.000829)	-0.00254*** (0.000833)	-0.00432*** (0.000985)	-0.00315*** (0.00112)
Socio-economic factors		#						#
Maternal Employment status			#					#
Attitude of mothers' towards healthcare service utilization				#				#
Women autonomy					#			
Reproductive behaviors of Women						#		#
Exposure to media							#	#
Regional control dummies	#	#	#	#	#	#	#	#
Rural	#	#	#	#	#	#	#	#
Other control variables	#	#	#	#	#	#	#	#
Constant (se)	0.292*** (0.0652)	0.219*** (0.0709)	0.291*** (0.0654)	0.318*** (0.0654)	0.301*** (0.0659)	0.187*** (0.0656)	0.294*** (0.0654)	0.154** (0.0728)
Number of observation	11,407	11,113	11,396	11,388	11,345	11,377	11,382	10,975

- Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
- Other control variables include: sex of the household head, age of the household head, age of the mother, mother height

Table 12 below summarizes the result obtained from the regression of the pooled data set. In all cases, the introduction of pathways did not bring a change in the level of significance of the coefficient for maternal education. But, the magnitude of the coefficient has changed when socio-economics factors and attitude towards health care service utilization are introduced. Therefore, for the whole dataset that combined observations from 2000, 2005 and 2011, only socio-economic factors and attitudes of health service use could mediate the effect of maternal education. But, their mediation is not very strong as the significance of the coefficient did not change when they are introduced. In addition, the significant coefficient on the last column show that maternal education has significant direct effect in reducing under-five mortality.

Table 12: Association of maternal education and identified pathways for the pooled data set

List of variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Maternal Education (in years)	-0.00403*** (0.000603)	-0.00302*** (0.000747)	-0.00413*** (0.000606)	-0.00328*** (0.000624)	-0.00397*** (0.000613)	-0.00389*** (0.000615)	-0.00169** (0.000763)
Socio-economic factors		#					#
Maternal Employment status			#				#
Attitude of mothers' towards healthcare service utilization				#			#
Women autonomy					#		#
Reproductive behaviors of Women						#	#
Regional control dummies	#	#	#	#	#	#	#
Rural	#	#	#	#	#	#	#
Other control variables	#	#	#	#	#	#	#
Constant	0.0918*** (0.0109)	0.169*** (0.0218)	0.0886*** (0.0110)	0.107*** (0.0117)	0.0925*** (0.0111)	0.0898*** (0.0156)	0.160*** (0.0251)
Number of observation	26,687	26,065	26,665	26,641	26,499	26,687	25,829

- Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
- Other control variables include: sex of the household head, age of the household head, age of the mother, mother height

From the above discussions we can draw the following three main conclusions.

First, the total effect of formal maternal education has decreased over time. The coefficient of maternal education after controlling for some variables is 0.00552, 0.00375, and 0.00322 in 2000, 2005, and 2011 respectively. A significant difference exist among these coefficients only if we consider 11% level of significance, with chi-square value of 4.51. On the other hand, the coefficients for maternal years of schooling in 2000 and 2005 are significantly different from each other. It confirms the significant decrease in the coefficient for maternal education from 2000 to 2005, though the decrease in 2011 is less strong. Generally, the coefficient for years of schooling is significant for all the three periods ($p<0.01$) and therefore we can claim that increasing maternal education is generally a significant factor in reducing under-five mortality.

Secondly, the direct effect of formal maternal education stayed almost the same in 2000 and 2005 and increased in 2011. The coefficient was not significant in 2000 and 2005 and became highly significant in 2011 ($p<0.01$).

Thirdly, pathways like socio-economic factors and attitude of mothers in health care service utilization had association with formal maternal education in 2000 and 2005. The association was stronger in 2005. Therefore, in these two periods formal maternal education was affecting under-five mortality through other factors. But, in 2011 maternal education had only a direct effect. It had no significant association with other factors and did not affect under-five mortality through other channels.

The strong association of maternal education and socio-economic factors in their effect of under-five mortality can be discussed by looking at individual variables included in socio-economic status. One of the socio-economic factors included in the study is fathers' education. More educated mothers will most probably be married to more educated and richer husbands. There was such find-

ing for Nigeria in Ikeako et al. (2006), where there is a significant association of maternal education and paternal education. More educated mothers will also have a better probability of getting highly paid job. These increases the likelihood that this mother belongs to a family with better socio-economic indicators. In addition, more educated mothers will most probably be better aware of child health issues and they can bring positive differences in the probability of under-five mortality compared to a child whose mother is less educated. More educated mothers were found to have better sanitary practices (Handa 1999), better access and use of safe water (Klaauw and Wang 2011) and these affected different child health indicators positively. On the other hand, some studies have found the significant effect of some of the socio-economic factors on child mortality and child nutritional status (Mohammed 2013, Mulugeta 2012). Therefore, this way maternal education affects socio-economic status of families and socio-economic factors in turn affect incidence of under-five mortality. This explains how socio-economic factors could mediate the effect of maternal education on under-five mortality, in 2000 and 2005.

In 2011, none of the channels tested could mediate the effect of maternal education on under-five mortality. This could have happened because of the changing intervention of Ethiopian government and its stakeholders in improving child health and improving access to health service to the general public. The Ethiopian government and its stakeholders were able to reach most families irrespective of their education level. This can be mainly due to the introduction of health extension program (HEP) in 2003. The program was pilot tested and became ready for scale-up in 2005[4] (Bilal 2012). "The health extension program (HEP) serves as the primary vehicle for prevention, health promotion, behavioral change communication, and basic curative care" Zachary et al. (2013). The HEP works for expansion of health care infrastructure and basic preventive and curative health care services in rural areas of the country.

In the HEP, there are two health officers in almost every locality (*kebele*[5]) and they go to every families' houses to provide health education and to motivate the people to go to health facilities. This increases the health knowledge of the people and their use of health services despite their difference in socio-economic status and mothers' formal education level. This can be a reason why the effect of formal maternal education on under-five mortality was associated with socio-economics factors and attitude of mothers in health care service utilization only before the intensive introduction of HEP. But, after the introduction of HEP, the association of formal maternal education and other factors disappeared.

Similarly, Mebratie et al. (2014) found no difference in awareness of people towards using modern health care. The basic reason given by this study was the spread of health care facilities and health care professionals after the introduction of the HEP, which enabled the provision of health services irrespective of differences in socio-economic status and education level. They stated that people were highly informed on the most frequent childhood disease. Due to the HEP, people in remote villages and rural areas have got improved access to health facilities and their use of health service have increased significantly (Bilal 2012). It was also confirmed that introduction of HEP has brought significant improvement in child immunization (Admassie et al. 2009). In addition, the same study confirmed that women in HEP start pregnancy visit to a health professional significantly earli-

[4] Therefore, the data from both 2000 EDHS and 2005 EDHS are almost free from the effect of HEP. It is only 2011 data which is affected by the countrywide introduction of the health extension service.
[5] *Kebele* is the lowest administrative unit in the Ethiopian administration system.

er than a pregnant women who is not in HEP. This explains why maternal education could affect under-five mortality through other channels in 2000 and 2005, but not in 2011.

Though the indirect effect of maternal education has disappeared in 2011, there is still significant direct effect of maternal education on under-five mortality. It shows that maternal education still has significant direct effect in reducing under-five mortality. In favor of this finding, Admassie et al. (2009) stated that, the effect of HEP in child immunization significantly differs between different levels of maternal education (despite the general positive effect). More educated mothers are therefore able to absorb a significantly higher benefit from universally provided health care facilities and services than less educated mothers.

The result has important implication. The positive effect of increasing maternal education can be brought by investing on other activities that can improve socio-economic status, increase use of health services, and improve reproductive behaviors of women. It shows that there is a substitution for formal maternal education to bring a significant improvement in child health. These choices can be more viable mainly because effect through formal schooling takes longer time. This implication is confirmed from decreasing total effect of maternal education due to introduction of HEP. Under-five mortality could be reduced through other factors, though the total effect of maternal education has decreased. But, maternal education still have significant effect (though decreasing over time). Therefore, investment in girls' schooling is still one of the important ways to contribute for child health improvement in the long run.

Chapter 5
Conclusions

Child health is one of the main indicators of development of a country. This paper aimed at contributing for the understanding of factors determining child health by investigating the effect of maternal education on incidence of under-five mortality. Studies have shown maternal education having both direct and indirect effects on different child health indicators.

The objectives of this study were to determine the effect of formal maternal schooling on under-five mortality and identifying channels through which maternal education may affect under-five mortality for the period between 2000 and 2011. The data was obtained from the 2000, 2005, and 2011 Ethiopian Demographic and Health Surveys (EDHS). The total number of observations used in the LPM regressions are 9765, 9532, 10975, and 25829 for the years 2000, 2005, 2011, and the pooled regressions respectively.

Set of socio-economic, bio-demographic, behavioural and environmental factors were included in the regressions made to find the partial effect of years of maternal schooling on incidence of under-five mortality. On the other hand; socio-economic factors, attitude towards use of health care services, reproductive behaviours of women, mothers' empowerment, and maternal employment status were tested for their mediation of the effect of maternal education on under-five mortality. First, LPM regression of occurrence of under-five mortality was done only on maternal years of schooling and control variables, to find the total effect of maternal education. Then, the group of variables (channels) were introduced one by one, to see if they are mediating the effect of maternal education. A big change in magnitude and significance level of the coefficient for maternal years of schooling confirms the presence of mediation. Similar steps were done for 2000, 2005, 2011 and the pooled data.

Mean of incidence of under-five mortality has decreased from 2000 to 2011. It was 11% in 2000, 9% in 2005, and 7% in 2011. For all the time periods, mean of incidence of under-five mortality was higher for children whose mothers have no formal education than children whose mothers have either primary or secondary level of education. Similarly, children whose mothers have only primary level of education have higher mean of mean of incidence of under-five mortality than children whose mothers have secondary and above secondary levels of education. For all the years 2000, 2005 and 2011; mothers whose children are alive have significantly higher mean of years of schooling than mothers whose children have died before the age of five ($P<0.01$). Likewise, children died before the age of five were found to come from families with significantly lower wealth index than the families of the children alive. Children who died before the age of five were found worse off in the means of other characteristics including pre-birth interval, type of floor materials, sanitation services, drinking water, visiting health facilities, modern contraceptive use, antenatal visit, and delivery in health facilities.

The LPM estimates showed that increasing years of maternal education reduces the probability of incidence of under-five mortality. But, the coefficients were small and found to be significant only for 2011. In 2011, the probability that a child will die before the age of five decreases by 0.32 percentage points for one more year of schooling.

In 2000, almost 50% of the total effect of maternal education was mediated through socio-economic factors. In this year, no other factor mediated the effect of maternal education on under-

five mortality. All the pathways together accounted for almost 60% of the total effect of maternal education and their mediation was significant. This was shown by a drop in significance level of coefficient for maternal education (from 1% to more than 10%), due to the inclusion of all the channels. Though not significant, the remaining 40% can be a direct effect of maternal education and the potential effect through unobserved factors. Generally, the total effect of formal maternal education on under-five mortality is significant.

In 2005, both socio-economic factors and attitude towards health care service utilisation were the channels through which maternal education affect under-five mortality. Like in 2000, the direct effect of maternal education was not significant in this year. Maternal education affects under-five mortality mainly through other channels and its total effect is significant.

In 2011, maternal education do not affect under-five mortality through other channels. It has a smaller but significant direct effect when compared to 2000 and 2005.

Generally, in all the three periods, education had significant total effect on under-five mortality. But, part of its effect was mediated by other factors only in 2000 and 2005. For 2011, no pathway mediated its effect. This could be mainly due to the universal access to health facilities and health knowledge created for the people of Ethiopia after the introduction of health extension program (HEP) from 2003. Due to this program, people had no difference in awareness towards using modern health care (Mebratie et al. 2014). The significant direct effect of years of maternal schooling in 2011 could be found due to the difference in the impact of HEP on children, with different groups of maternal education. More educated mothers were able to achieve significantly higher benefits (from HEP) in terms of child health than mothers with lower formal education level (Admassie et al. 2009).

The results imply that big part of the effect of maternal education can be substituted by investing in other factors that can improve socio-economic status, use of health services, and health behaviours of women. It shows that there is a substitution for formal maternal education to bring a significant improvement in child health. These choices can be more viable mainly because effect through formal schooling takes longer time. But, investment in girls' schooling is still one of the important ways to contribute for child health improvement in the long run.

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Appendices

Appendix 1: Determinants of Under-five mortality in Ethiopia from the year 2000 to 2011

VARIABLES	(1) 2000	(2) 2005	(3) 2011	(4) Total
Mother education level in single years	-0.00225	-0.00212	-0.00315***	-0.00169**
	(0.00150)	(0.00141)	(0.00112)	(0.000763)
Sex of household head (1=female)	0.0111	-0.000885	-0.00692	-0.000251
	(0.00888)	(0.00862)	(0.00674)	(0.00498)
Sex of the child (1=female)	-0.00579	-0.0215***	-0.00912*	-0.0120***
	(0.00613)	(0.00561)	(0.00481)	(0.00346)
Age of the household head	0.00205***	0.00177***	0.000803***	0.00153***
	(0.000325)	(0.000326)	(0.000243)	(0.000183)
Age of the mother (reference age:15-19 years)				
Current age of the mother (20-34)	-0.000797	-0.0334***	-0.0501***	-0.0277***
	(0.00928)	(0.00932)	(0.00818)	(0.00528)
Current age of the mother (>=35)	0.0348**	-0.0759***	-0.0514***	-0.0173**
	(0.0142)	(0.0149)	(0.0129)	(0.00872)
Mothers' Body Mass Index (BMI)			2.03e-05**	
			(9.63e-06)	
Mothers' height in centimeters	-0.00012***		-0.00014***	-2.84e-06*
	(4.49e-05)		(3.96e-05)	(1.59e-06)
Floor material (1=improved)	-0.00262	-0.00952	0.0167*	0.0152***
	(0.0115)	(0.0116)	(0.00994)	(0.00520)
Source of drinking water (1=improved)	0.000716	0.00951	-0.00217	-0.00255
	(0.00922)	(0.00618)	(0.00567)	(0.00413)
Sanitation (1=improved)	0.0121	0.00628	-0.0124*	-0.00166
	(0.0110)	(0.00773)	(0.00740)	(0.00510)
Electricity access (1=Yes)	-0.0273	0.000893	0.00702	-0.00650
	(0.0185)	(0.0147)	(0.0113)	(0.00804)
Husband (partner) is employed	-0.0396	0.0184	0.0280	-0.00132
	(0.0331)	(0.0297)	(0.0193)	(0.0169)
Wealth index (reference group: poorest)				
Poorer	-	0.00548	0.00264	-
		(0.00922)	(0.00777)	
Middle	-	0.0143	0.00210	-
		(0.00987)	(0.00827)	
Richer	-	0.00777	-0.00743	-
		(0.0102)	(0.00871)	
Richest	-	-0.0118	-0.00257	-
		(0.0124)	(0.0143)	
Paternal education in groups (reference: No-education)				
Primary education	-0.00655	-0.0111	-0.00232	-0.00494
	(0.00851)	(0.00724)	(0.00579)	(0.00433)
Secondary education	-0.0142	-0.0212**	-0.000817	-0.00966
	(0.0123)	(0.0106)	(0.0103)	(0.00715)
Above secondary level of education	-0.0409**	-0.0414**	0.00696	-0.0169
	(0.0191)	(0.0163)	(0.0143)	(0.0105)
Household size	-0.0254***	-0.0300***	-0.0181***	-0.0236***
	(0.00179)	(0.00218)	(0.00164)	(0.00113)
Mother participating in a paid work (1=Yes)	0.00853	0.0187***	0.00309	0.00835**
	(0.00661)	(0.00706)	(0.00560)	(0.00388)
The mother visited health facility in last 12 months	-0.0213***	0.0151	-0.00111	-0.0105***
	(0.00642)	(0.0118)	(0.00522)	(0.00393)
The family has health insurance	-	-	0.0117	-
			(0.0326)	
The mother uses modern contraceptive method	0.00485	-0.0199**	-0.0382***	-0.0203***

VARIABLES	(1) 2000	(2) 2005	(3) 2011	(4) Total
	(0.0109)	(0.00845)	(0.00620)	(0.00487)
Religion (reference: Orthodox)				
Catholic	-0.00731	-0.0190	0.0344	0.0157
	(0.0356)	(0.0280)	(0.0317)	(0.0214)
Protestant	-0.00462	-0.00135	-0.00599	-0.00844
	(0.0117)	(0.0104)	(0.00989)	(0.00671)
Muslim	0.0203**	-0.00545	-0.00528	0.00595
	(0.00931)	(0.00848)	(0.00810)	(0.00553)
Traditional	-0.0146	-0.0416**	0.00494	-0.0120
	(0.0193)	(0.0187)	(0.0320)	(0.0145)
Beating is justified if wife leaves to her parents' home without telling husband/partner	0.00444	0.00765	-0.00495	-0.00115
	(0.00659)	(0.00619)	(0.00510)	(0.00368)
Breast feeding (breast feeding for more 6 months – reference: less than six months of breast feeding)	-		0.0706***	-
			(0.00351)	
Age of the mother at first birth	-0.000349	0.00209**	0.00104	7.48e-05
	(0.00109)	(0.00105)	(0.000893)	(0.000628)
Child has twin (1=Yes)	0.283***	0.158***	0.198***	0.221***
	(0.0399)	(0.0318)	(0.0239)	(0.0189)
Size of child at birth (1=large) –reference is small	-	0.00350	0.0161***	-
		(0.00633)	(0.00517)	
Total number of children born from the same mother	0.00500**	0.0376***	0.0260***	0.0116***
	(0.00224)	(0.00348)	(0.00295)	(0.00139)
Parity (birth order number) – reference is first				
Second and third	-	-0.0527***	-0.0216**	-
		(0.0100)	(0.00854)	
Fourth and fifth	-	-0.0780***	-0.0437***	-
		(0.0143)	(0.0126)	
Six and greater	-	-0.123***	-0.0922***	-
		(0.0213)	(0.0187)	
Wanted pregnancy (1=Yes)	-	0.00860	0.0106	-
		(0.00850)	(0.00951)	
Mother listens radio	-	0.0149**	0.0123**	-
		(0.00703)	(0.00563)	
Mother watches television	-	0.00472	0.00164	-
		(0.0123)	(0.00676)	
Mother reads newspapers/magazine	-	0.0128	0.0129	-
		(0.0120)	(0.0114)	
Distance to health facility (1=big problem)	-	0.000578	0.00399	-
		(0.00677)	(0.00608)	
Rural (=1)	-0.0315**	-0.0126	-0.0108	-0.0201***
	(0.0158)	(0.0144)	(0.0109)	(0.00776)
Region Dummies (reference: Addis Ababa)				
Tigray	-0.0116	-0.0390**	0.0195	-0.000309
	(0.0182)	(0.0172)	(0.0146)	(0.0103)
Afar	0.0529**	0.0101	0.0398**	0.0353***
	(0.0215)	(0.0201)	(0.0157)	(0.0115)
Amhara	0.000798	0.0102	0.0326**	0.0155
	(0.0178)	(0.0173)	(0.0148)	(0.0103)
Oromia	0.0242	-0.00741	0.0249*	0.0154
	(0.0172)	(0.0161)	(0.0140)	(0.00974)
Somali	-0.0174	-0.0148	0.0322**	0.000477
	(0.0196)	(0.0199)	(0.0155)	(0.0109)
Benishangul Gumz	0.00695	-0.00956	0.0433***	0.0229**
	(0.0191)	(0.0183)	(0.0157)	(0.0108)
SNNP	0.0257	0.00356	0.0294*	0.0297***
	(0.0182)	(0.0172)	(0.0150)	(0.0105)
Gambella	0.0705***	-0.00588	0.0606***	0.0540***
	(0.0214)	(0.0190)	(0.0173)	(0.0120)

VARIABLES	(1) 2000	(2) 2005	(3) 2011	(4) Total
Harari	0.0155	-0.0259	0.0259*	0.0111
	(0.0178)	(0.0165)	(0.0155)	(0.0104)
Dire Dawa	0.0244	-0.00284	-0.000695	0.00873
	(0.0179)	(0.0178)	(0.0138)	(0.0105)
Time Dummies (reference: 2000)				
2005	-	-	-	-0.0201***
				(0.00671)
2011	-	-	-	-0.0186***
				(0.00440)
Constant	0.384***	0.0932**	0.154**	0.160***
	(0.0838)	(0.0469)	(0.0728)	(0.0251)
Observations	9,765	9,532	10,975	25,829
R-squared	0.063	0.058	0.062	0.050

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Appendix 2: Association between maternal education and different pathways in 2000

VARIABLES	(1) U5M	(2) U5M	(3) U5M	(4) U5M	(5) U5M	(6) U5M	(7) U5M
Mother education level in single years	-0.00552***	-0.00287**	-0.00559***	-0.00445***	-0.00553***	-0.00590***	-0.00225
	(0.00109)	(0.00144)	(0.00109)	(0.00115)	(0.00111)	(0.00111)	(0.00150)
Sex of household head (1=female)	0.0406***	0.0112	0.0399***	0.0391***	0.0421***	0.0372***	0.0111
	(0.00827)	(0.00871)	(0.00827)	(0.00840)	(0.00832)	(0.00833)	(0.00888)
Sex of the child (1=female)	-0.00376	-0.00367	-0.00380	-0.00426	-0.00476	-0.00470	-0.00579
	(0.00617)	(0.00615)	(0.00617)	(0.00616)	(0.00619)	(0.00613)	(0.00613)
Age of the household head	0.000922***	0.00203***	0.000929***	0.000865***	0.000926***	0.000976***	0.00205***
	(0.000302)	(0.000326)	(0.000302)	(0.000302)	(0.000303)	(0.000300)	(0.000325)
Age of the mother (reference age:15-19 years)							
Current age of the mother (20-34)	-0.00971	0.00666	-0.0101	-0.00895	-0.00861	0.00180	-0.000797
	(0.00789)	(0.00810)	(0.00793)	(0.00789)	(0.00791)	(0.00906)	(0.00928)
Current age of the mother (>=35)	0.0360***	0.0566***	0.0353***	0.0356***	0.0369***	0.0624***	0.0348**
	(0.00952)	(0.00993)	(0.00959)	(0.00953)	(0.00954)	(0.0136)	(0.0142)
Mothers' height in centimeters	-	-	-	-	-	-	-
	0.000187***	0.000120***	0.000187***	0.000178***	0.000187***	0.000193***	0.000123***
	(4.60e-05)	(4.50e-05)	(4.61e-05)	(4.59e-05)	(4.61e-05)	(4.59e-05)	(4.49e-05)
Floor material (1=improved)	-	-0.00518	-	-	-	-	-0.00262
		(0.0114)					(0.0115)
Source of drinking water (1=improved)	-	-0.00211	-	-	-	-	0.000716
		(0.00921)					(0.00922)
Sanitation (1=improved)	-	0.0102	-	-	-	-	0.0121
		(0.0110)					(0.0110)
Electricity access (1=Yes)	-	-0.0303	-	-	-	-	-0.0273
		(0.0185)					(0.0185)
Husband (partner) is employed	-	-0.0397	-	-	-	-	-0.0396
		(0.0329)					(0.0331)
Paternal education in groups (reference: No-education)							
Primary education	-	-0.0104	-	-	-	-	-0.00655
		(0.00849)					(0.00851)
Secondary education	-	-0.0234*	-	-	-	-	-0.0142
		(0.0121)					(0.0123)
Above secondary level of education	-	-0.0478**	-	-	-	-	-0.0409**
		(0.0186)					(0.0191)
Household size	-	-0.0233***	-	-	-	-	-0.0254***

VARIABLES	(1) U5M	(2) U5M	(3) U5M	(4) U5M	(5) U5M	(6) U5M	(7) U5M
		(0.00157)					(0.00179)
Rural (=1)	-0.00890	-0.0282*	-0.00968	-0.0140	-0.00945	-0.00626	-0.0315**
	(0.0111)	(0.0159)	(0.0112)	(0.0115)	(0.0112)	(0.0112)	(0.0158)
Region Dummies (reference: Addis Ababa)							
Tigray	-0.00603	-0.0230	-0.00768	0.00158	-0.00424	0.000112	-0.0116
	(0.0158)	(0.0175)	(0.0160)	(0.0163)	(0.0159)	(0.0158)	(0.0182)
Afar	0.0754***	0.0599***	0.0753***	0.0642***	0.0762***	0.0785***	0.0529**
	(0.0197)	(0.0210)	(0.0197)	(0.0203)	(0.0197)	(0.0196)	(0.0215)
Amhara	0.0206	-0.00378	0.0193	0.0204	0.0216	0.0267*	0.000798
	(0.0156)	(0.0173)	(0.0157)	(0.0159)	(0.0157)	(0.0155)	(0.0178)
Oromia	0.0260*	0.0191	0.0261*	0.0284*	0.0274*	0.0341**	0.0242
	(0.0153)	(0.0171)	(0.0153)	(0.0153)	(0.0153)	(0.0153)	(0.0172)
Somali	0.00652	-0.0111	0.00807	-0.00566	0.00919	0.0135	-0.0174
	(0.0173)	(0.0189)	(0.0173)	(0.0180)	(0.0174)	(0.0172)	(0.0196)
Benishangul Gumz	0.0221	0.000976	0.0211	0.0240	0.0242	0.0277	0.00695
	(0.0175)	(0.0190)	(0.0175)	(0.0175)	(0.0176)	(0.0174)	(0.0191)
SNNP	0.0279*	0.0119	0.0280*	0.0446***	0.0296*	0.0343**	0.0257
	(0.0156)	(0.0173)	(0.0156)	(0.0166)	(0.0157)	(0.0156)	(0.0182)
Gambella	0.0708***	0.0531***	0.0718***	0.0899***	0.0733***	0.0711***	0.0705***
	(0.0187)	(0.0205)	(0.0188)	(0.0198)	(0.0188)	(0.0186)	(0.0214)
Harari	0.0354**	0.0252	0.0352**	0.0292*	0.0344**	0.0420**	0.0155
	(0.0165)	(0.0173)	(0.0165)	(0.0167)	(0.0165)	(0.0165)	(0.0178)
Dire Dawa	0.0487***	0.0315*	0.0477***	0.0431**	0.0501***	0.0515***	0.0244
	(0.0168)	(0.0176)	(0.0168)	(0.0170)	(0.0168)	(0.0168)	(0.0179)
Mother participating in a paid work (1=Yes)	-	-	0.00646		-	-	0.00853
			(0.00658)				(0.00661)
The mother visited health facility in last 12 months	-	-	-	-0.0267***	-	-	-0.0213***
				(0.00644)			(0.00642)
The mother uses modern contraceptive method	-	-	-	0.00161	-	-	0.00485
				(0.0107)			(0.0109)
Religion (reference: Orthodox)							
Catholic	-	-	-	-0.0217	-	-	-0.00731
				(0.0349)			(0.0356)
Protestant	-	-	-	-0.0215*	-	-	-0.00462
				(0.0116)			(0.0117)
Muslim	-	-	-	0.0170*	-	-	0.0203**
				(0.00914)			(0.00931)

VARIABLES	(1) U5M	(2) U5M	(3) U5M	(4) U5M	(5) U5M	(6) U5M	(7) U5M
Traditional	-	-	-	-0.0106	-	-	-0.0146
				(0.0193)			(0.0193)
Beating is justified if wife leaves to her parents' home without telling husband/partner	-	-	-	-	0.00272	-	0.00444
					(0.00664)		(0.00659)
Age of the mother at first birth	-	-	-	-	-	-0.000916	-0.000349
				-	-	(0.00107)	(0.00109)
Child has twin (1=Yes)	-	-	-	-	-	0.298***	0.283***
						(0.0412)	(0.0399)
Total number of children born from the same mother	-	-	-	-	-	-0.00618***	0.00500**
						(0.00198)	(0.00224)
Constant	0.334***	0.384***	0.332***	0.332***	0.330***	0.360***	0.384***
	(0.0733)	(0.0812)	(0.0734)	(0.0732)	(0.0735)	(0.0753)	(0.0838)
Observations	10,068	9,851	10,064	10,067	9,982	10,068	9,765
R-squared	0.021	0.048	0.021	0.023	0.021	0.034	0.063

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Appendix 3: Association between maternal education level and different pathways in 2005

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	U5M	U5M	U5M	U5M	U5M	U5M	U5M
Mother education level in single years	-0.00375***	-0.00116	-0.00384***	-0.00165	-0.00395***	-0.00475***	-0.00212
	(0.00107)	(0.00125)	(0.00107)	(0.00126)	(0.00106)	(0.00128)	(0.00141)
Sex of household head (1=female)	0.0105	0.000631	0.00892	-0.000815	0.0127	0.0110	-0.000885
	(0.00864)	(0.00872)	(0.00865)	(0.00870)	(0.00853)	(0.00869)	(0.00862)
Sex of the child (1=female)	-0.0196***	-0.0198***	-0.0198***	-0.0198***	-0.0210***	-0.0193***	-0.0215***
	(0.00565)	(0.00567)	(0.00566)	(0.00562)	(0.00560)	(0.00568)	(0.00561)
Age of the household head	0.000389	0.00149***	0.000417	0.00149***	0.000170	0.000401	0.00177***
	(0.000302)	(0.000322)	(0.000302)	(0.000320)	(0.000301)	(0.000304)	(0.000326)
Age of the mother (reference age:15-19 years)							
Current age of the mother (20-34)	-0.0209***	-0.000298	-0.0219***	-0.00447	-0.0316***	-0.0214***	-0.0334***
	(0.00717)	(0.00750)	(0.00719)	(0.00747)	(0.00927)	(0.00720)	(0.00932)
Current age of the mother (>=35)	-0.0189**	0.0205**	-0.0207**	0.0166	-0.0609***	-0.0187**	-0.0759***
	(0.00941)	(0.0104)	(0.00947)	(0.0104)	(0.0148)	(0.00945)	(0.0149)
Floor material (1=improved)		0.0130		0.0172			0.00952
		(0.0118)		(0.0116)			(0.0116)
Source of drinking water (1=improved)		-0.00987		-0.00994			-0.00951
		(0.00627)		(0.00624)			(0.00618)
Sanitation (1=improved)		-0.00122		-0.00204			-0.00628
		(0.00781)		(0.00774)			(0.00773)
Electricity access (1=Yes)		-0.00125		0.00102			0.000893
		(0.0145)		(0.0145)			(0.0147)
Husband (partner) is employed		-0.0176		0.0284			0.0184
		(0.0372)		(0.0283)			(0.0297)
Wealth dummies (reference: Poorest)							
Poorer		0.00684		0.00687			0.00548
		(0.00936)		(0.00933)			(0.00922)
Rich		0.0218**		0.0184*			0.0143
		(0.00994)		(0.00988)			(0.00987)
Richer		0.0164		0.0144			0.00777
		(0.0103)		(0.0103)			(0.0102)
richest		-0.00556		-0.00572			-0.0118
		(0.0121)		(0.0122)			(0.0124)
Paternal education in groups (reference: No-education)							
Primary education		-0.0127*		-0.0107			-0.0111

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
		(0.00733)		(0.00733)			(0.00724)
Secondary education		-0.0290***		-0.0263**			-0.0212**
		(0.0107)		(0.0107)			(0.0106)
Above secondary level of education		-0.0410**		-0.0528***			-0.0414**
		(0.0176)		(0.0164)			(0.0163)
Household size		-0.0202***		-0.0194***			-0.0300***
		(0.00177)		(0.00176)			(0.00218)
Mother participating in a paid work (1=Yes)			0.0196***	0.0171**			0.0187***
			(0.00718)	(0.00712)			(0.00706)
The mother visited health facility in last 12 months				0.0149			0.0151
				(0.0118)			(0.0118)
The mother uses modern contraceptive method				-0.0196**			-0.0199**
				(0.00853)			(0.00845)
Religion (reference: Orthodox)							
Catholic				-0.0182			-0.0190
				(0.0277)			(0.0280)
Protestant				-0.00142			-0.00135
				(0.0104)			(0.0104)
Muslim				-0.00338			-0.00545
				(0.00862)			(0.00848)
Traditional				-0.0441**			-0.0416**
				(0.0185)			(0.0187)
Beating is justified if wife leaves to her parents' home without telling husband/partner							0.00765
							(0.00619)
Age of the mother at first birth					0.00227**		0.00209**
					(0.00104)		(0.00105)
Child has twin (1=Yes)					0.158***		0.158***
					(0.0328)		(0.0318)
Size of the child at birth (1=big)					-7.67e-05		0.00350
					(0.00637)		(0.00633)
Total number of children born from the same mother					0.0245***		0.0376***
					(0.00318)		(0.00348)
Parity (birth order number) – reference is first							
Second and third					-0.0563***		-0.0527***
					(0.0100)		(0.0100)
Fourth and fifth					-0.0883***		-0.0780***
					(0.0142)		(0.0143)
Six and greater					-0.134***		-0.123***

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
					(0.0212)		(0.0213)
Wanted pregnancy (1=Yes)					0.0108		0.00860
					(0.00838)		(0.00850)
Mother listens radio						0.00162	0.0149**
						(0.00693)	(0.00703)
Mother watches television						-0.000436	0.00472
						(0.0122)	(0.0123)
Mother reads newspapers/magazine						0.0146	0.0128
						(0.0122)	(0.0120)
Distance to health facility (1=big problem)	-0.00280	-0.00143	-0.00317	-0.00171	-0.00188	-0.00246	0.000578
	(0.00682)	(0.00692)	(0.00682)	(0.00688)	(0.00672)	(0.00687)	(0.00677)
Rural (=1)	0.00999	-0.0109	0.0125	-0.0104	0.000416	0.0103	-0.0126
	(0.0106)	(0.0140)	(0.0105)	(0.0145)	(0.0106)	(0.0116)	(0.0144)
Region Dummies (reference: Addis Ababa)							
Tigray	-0.0150	-0.0323*	-0.0154	-0.0391**	-0.00723	-0.0156	-0.0390**
	(0.0163)	(0.0171)	(0.0162)	(0.0173)	(0.0160)	(0.0164)	(0.0172)
Afar	0.0107	0.0148	0.0144	0.0128	0.00861	0.0114	0.0101
	(0.0189)	(0.0200)	(0.0188)	(0.0202)	(0.0187)	(0.0191)	(0.0201)
Amhara	0.0337**	0.0147	0.0334**	0.00847	0.0402**	0.0340**	0.0102
	(0.0164)	(0.0174)	(0.0163)	(0.0174)	(0.0161)	(0.0166)	(0.0173)
Oromia	0.00808	0.00604	0.00717	0.000709	0.00606	0.00836	-0.00741
	(0.0155)	(0.0164)	(0.0155)	(0.0163)	(0.0152)	(0.0156)	(0.0161)
Somali	0.00968	0.00176	0.0129	-0.00971	-0.00545	0.0114	-0.0148
	(0.0187)	(0.0201)	(0.0186)	(0.0200)	(0.0180)	(0.0190)	(0.0199)
Benishangul Gumz	0.0108	-0.00155	0.00884	-0.00650	0.0136	0.0117	-0.00956
	(0.0178)	(0.0186)	(0.0177)	(0.0185)	(0.0175)	(0.0180)	(0.0183)
SNNP	0.0162	0.0113	0.0168	0.00844	0.0173	0.0168	0.00356
	(0.0157)	(0.0170)	(0.0156)	(0.0173)	(0.0154)	(0.0159)	(0.0172)
Gambella	-0.00962	-0.0163	-0.00945	-0.0174	0.00259	-0.00698	-0.00588
	(0.0173)	(0.0187)	(0.0173)	(0.0190)	(0.0171)	(0.0177)	(0.0190)
Harari	-0.0103	-0.0132	-0.0108	-0.0248	-0.0177	-0.00922	-0.0259
	(0.0165)	(0.0165)	(0.0164)	(0.0166)	(0.0160)	(0.0166)	(0.0165)
Dire Dawa	0.00284	0.00725	0.00457	0.00752	-0.00461	0.00295	-0.00284
	(0.0177)	(0.0178)	(0.0177)	(0.0180)	(0.0176)	(0.0177)	(0.0178)
Constant	0.0841***	0.181***	0.0779***	0.134***	0.0260	0.0822***	0.0932**
	(0.0192)	(0.0450)	(0.0190)	(0.0406)	(0.0283)	(0.0209)	(0.0469)
Observations	9,860	9,695	9,858	9,650	9,819	9,815	9,532
R-squared	0.007	0.027	0.008	0.029	0.024	0.007	0.058

Appendix 4: Association between maternal education and other pathways in 2011

VARIABLES	(1) U5M	(2) U5M	(3) U5M	(4) U5M	(5) U5M	(6) U5M	(7) U5M	(8) U5M
Mother education level in single years	-0.00322***	-0.00394***	-0.00328***	-0.00279***	-0.00311***	-0.00254***	-0.00432***	-0.00315***
	(0.000821)	(0.000998)	(0.000826)	(0.000858)	(0.000829)	(0.000833)	(0.000985)	(0.00112)
Sex of household head (1=female)	0.00244	-0.00559	0.00197	-0.000109	0.00306	0.00548	0.000825	-0.00692
	(0.00641)	(0.00679)	(0.00645)	(0.00647)	(0.00643)	(0.00630)	(0.00638)	(0.00674)
Sex of the child (1=female)	-0.0121**	-0.0120**	-0.0121**	-0.0115**	-0.0117**	-0.0104**	-0.0121**	-0.00912*
	(0.00485)	(0.00491)	(0.00486)	(0.00485)	(0.00486)	(0.00475)	(0.00485)	(0.00481)
Age of the household head	-0.000207	0.000667***	-0.000204	-0.000283	-0.000206	-0.000259	-0.000209	0.000803***
	(0.000220)	(0.000247)	(0.000220)	(0.000221)	(0.000221)	(0.000213)	(0.000220)	(0.000243)
Age of the mother (reference age:15-19 years)								
Current age of the mother (20-34)	-0.0258***	-0.0190***	-0.0262***	-0.0264***	-0.0265***	-0.0424***	-0.0260***	-0.0501***
	(0.00621)	(0.00645)	(0.00622)	(0.00623)	(0.00622)	(0.00800)	(0.00620)	(0.00818)
Current age of the mother (>=35)	-0.00458	0.0120	-0.00502	-0.00436	-0.00387	-0.0393***	-0.00433	-0.0514***
	(0.00802)	(0.00868)	(0.00801)	(0.00804)	(0.00807)	(0.0126)	(0.00802)	(0.0129)
Mothers' BMI	1.41e-05	2.37e-05**	1.43e-05	1.42e-05	1.36e-05	1.29e-05	1.42e-05	2.03e-05**
	(9.13e-06)	(9.73e-06)	(9.14e-06)	(9.10e-06)	(9.13e-06)	(9.04e-06)	(9.19e-06)	(9.63e-06)
Mother's height in centimeters	-	-	-	-	-	-	-	-
	0.000154***	0.000114***	0.000154***	0.000155***	0.000156***	0.000167***	0.000157***	0.000140***
	(3.91e-05)	(3.98e-05)	(3.92e-05)	(3.92e-05)	(3.96e-05)	(3.86e-05)	(3.91e-05)	(3.96e-05)
Floor material (1=improved)		0.00793						0.0167*
		(0.01000)						(0.00994)
Source of drinking water (1=improved)		-0.00229						-0.00217
		(0.00576)						(0.00567)
Sanitation (1=improved)		-0.0123						-0.0124*
		(0.00753)						(0.00740)
Electricity access (1=Yes)		-0.000371						0.00702
		(0.0113)						(0.0113)
Husband (partner) is employed		0.0272						0.0280
		(0.0183)						(0.0193)
Wealth dummies (reference: Poorest)								
Poorer		0.00120						0.00264
		(0.00799)						(0.00777)
Rich		-0.00214						0.00210
		(0.00843)						(0.00827)

VARIABLES	(1) U5M	(2) U5M	(3) U5M	(4) U5M	(5) U5M	(6) U5M	(7) U5M	(8) U5M
Richer		-0.0106						-0.00743
		(0.00859)						(0.00871)
richest		0.000767						-0.00257
		(0.0143)						(0.0143)
Paternal education in groups (reference: No-education)								
Primary education		-0.00494						-0.00232
		(0.00582)						(0.00579)
Secondary education		-7.58e-05						-0.000817
		(0.0107)						(0.0103)
Above secondary level of education		0.00442						0.00696
		(0.0147)						(0.0143)
Household size		-0.0130***						-0.0181***
		(0.00137)						(0.00164)
Distance to health facility (1=big problem)	0.00351	0.00498	0.00351	0.00210	0.00363	0.00191	0.00551	0.00399
	(0.00605)	(0.00627)	(0.00606)	(0.00608)	(0.00608)	(0.00588)	(0.00603)	(0.00608)
Rural (=1)	-0.00755	-0.00693	-0.00691	-0.0115	-0.00928	-0.00666	-0.00775	-0.0108
	(0.00859)	(0.0111)	(0.00863)	(0.00872)	(0.00864)	(0.00837)	(0.00879)	(0.0109)
Region Dummies (reference: Addis Ababa)								
Tigray	0.0221	0.0326**	0.0221	0.0122	0.0215	0.0208	0.0227*	0.0195
	(0.0136)	(0.0143)	(0.0136)	(0.0143)	(0.0136)	(0.0134)	(0.0137)	(0.0146)
Afar	0.0391***	0.0521***	0.0401***	0.0345**	0.0379**	0.0357**	0.0391***	0.0398**
	(0.0147)	(0.0155)	(0.0147)	(0.0151)	(0.0148)	(0.0146)	(0.0149)	(0.0157)
Amhara	0.0232*	0.0321**	0.0231*	0.0171	0.0236*	0.0293**	0.0237*	0.0326**
	(0.0138)	(0.0145)	(0.0138)	(0.0142)	(0.0139)	(0.0137)	(0.0139)	(0.0148)
Oromia	0.0275**	0.0382***	0.0268**	0.0256*	0.0273**	0.0257**	0.0269**	0.0249*
	(0.0132)	(0.0139)	(0.0132)	(0.0133)	(0.0132)	(0.0130)	(0.0132)	(0.0140)
Somali	0.0329**	0.0541***	0.0335**	0.0270*	0.0287**	0.0256*	0.0336**	0.0322**
	(0.0143)	(0.0153)	(0.0143)	(0.0148)	(0.0143)	(0.0143)	(0.0145)	(0.0155)
Benishangul Gumz	0.0486***	0.0570***	0.0478***	0.0463***	0.0491***	0.0421***	0.0493***	0.0433***
	(0.0149)	(0.0156)	(0.0150)	(0.0151)	(0.0150)	(0.0147)	(0.0152)	(0.0157)
SNNP	0.0325**	0.0415***	0.0317**	0.0324**	0.0315**	0.0297**	0.0329**	0.0294*
	(0.0136)	(0.0142)	(0.0136)	(0.0148)	(0.0136)	(0.0134)	(0.0137)	(0.0150)
Gambella	0.0520***	0.0708***	0.0516***	0.0501***	0.0507***	0.0445***	0.0516***	0.0606***
	(0.0155)	(0.0167)	(0.0155)	(0.0170)	(0.0156)	(0.0150)	(0.0158)	(0.0173)
Harari	0.0246*	0.0386**	0.0243*	0.0238	0.0239*	0.0217	0.0251*	0.0259*

VARIABLES	(1) U5M	(2) U5M	(3) U5M	(4) U5M	(5) U5M	(6) U5M	(7) U5M	(8) U5M
	(0.0144)	(0.0152)	(0.0144)	(0.0148)	(0.0144)	(0.0142)	(0.0144)	(0.0155)
Dire Dawa	0.00689	0.0110	0.00677	0.00394	0.00678	0.00318	0.00645	-0.000695
	(0.0135)	(0.0137)	(0.0135)	(0.0137)	(0.0135)	(0.0132)	(0.0135)	(0.0138)
Mother participating in a paid work (1=Yes)			0.00466					0.00309
			(0.00555)					(0.00560)
The mother visited health facility in last 12 months				-0.00172				-0.00111
				(0.00524)				(0.00522)
Participation in health insurance scheme				0.0319				0.0117
				(0.0360)				(0.0326)
The mother uses modern contraceptive method				-0.0286***				-0.0382***
				(0.00598)				(0.00620)
Religion (reference: Orthodox)								
Catholic				0.0372				0.0344
				(0.0327)				(0.0317)
Protestant				-0.0139				-0.00599
				(0.0101)				(0.00989)
Muslim				-0.00955				-0.00528
				(0.00814)				(0.00810)
Traditional				0.00443				0.00494
				(0.0315)				(0.0320)
Beating is justified if wife leaves to her parents' home without telling husband/partner					-0.00605			-0.00495
					(0.00515)			(0.00510)
Breast feeding for more than 6 months (<6 months is reference group)						0.0712***		0.0706***
						(0.00309)		(0.00351)
Age of the mother at first birth						0.00129		0.00104
						(0.000871)		(0.000893)
Child has twin (1=Yes)						0.203***		0.198***
						(0.0241)		(0.0239)
Size of the child at birth (1=big)						0.0143***		0.0161***
						(0.00510)		(0.00517)
Total number of children born from the same mother						0.0194***		0.0260***
						(0.00277)		(0.00295)
Parity (birth order number) – reference is first								

VARIABLES	(1) U5M	(2) U5M	(3) U5M	(4) U5M	(5) U5M	(6) U5M	(7) U5M	(8) U5M
Second and third						-0.0253***		-0.0216**
						(0.00840)		(0.00854)
Fourth and fifth						-0.0545***		-0.0437***
						(0.0124)		(0.0126)
Six and greater						-0.104***		-0.0922***
						(0.0186)		(0.0187)
Wanted pregnancy (1=Yes)						0.00738		0.0106
						(0.00941)		(0.00951)
Mother listens radio							0.00457	0.0123**
							(0.00555)	(0.00563)
Mother watches television							-0.000264	0.00164
							(0.00660)	(0.00676)
Mother reads newspapers/magazine							0.0160	0.0129
							(0.0112)	(0.0114)
Constant	0.292***	0.219***	0.291***	0.318***	0.301***	0.187***	0.294***	0.154**
	(0.0652)	(0.0709)	(0.0654)	(0.0654)	(0.0659)	(0.0656)	(0.0654)	(0.0728)
Observations	11,407	11,113	11,396	11,388	11,345	11,377	11,382	10,975
R-squared	0.008	0.019	0.008	0.010	0.008	0.043	0.008	0.062

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Appendix 5: Association of maternal education and identified pathways for the pooled data set

VARIABLES	(1) U5M	(2) U5M	(3) U5M	(4) U5M	(5) U5M	(6) U5M	(7) U5M
Mother education level in single years	-0.00403***	-0.00302***	-0.00413***	-0.00328***	-0.00397***	-0.00389***	-0.00169**
	(0.000603)	(0.000747)	(0.000606)	(0.000624)	(0.000613)	(0.000615)	(0.000763)
Sex of household head (1=female)	0.0189***	0.00317	0.0181***	0.0169***	0.0196***	0.0177***	-0.000251
	(0.00476)	(0.00495)	(0.00477)	(0.00479)	(0.00478)	(0.00474)	(0.00498)
Sex of the child (1=female)	-0.0111***	-0.0113***	-0.0110***	-0.0112***	-0.0112***	-0.0114***	-0.0120***
	(0.00348)	(0.00349)	(0.00348)	(0.00347)	(0.00349)	(0.00346)	(0.00346)
Age of the household head	0.000339**	0.00143***	0.000347**	0.000293*	0.000345**	0.000302*	0.00153***
	(0.000167)	(0.000183)	(0.000167)	(0.000168)	(0.000168)	(0.000166)	(0.000183)
Age of the mother (reference age:15-19 years)							
Current age of the mother (20-34)	-0.0195***	-0.00595	-0.0201***	-0.0197***	-0.0193***	-0.0232***	-0.0277***
	(0.00440)	(0.00454)	(0.00441)	(0.00439)	(0.00441)	(0.00518)	(0.00528)
Current age of the mother (>=35)	0.0104*	0.0334***	0.00954*	0.0103*	0.0107*	0.00370	-0.0173**
	(0.00556)	(0.00590)	(0.00558)	(0.00556)	(0.00558)	(0.00850)	(0.00872)
Mothers' height in centimeters	-3.37e-06**	-3.74e-06**	-3.72e-06**	-3.19e-06**	-3.58e-06**	-3.36e-06**	-2.84e-06*
	(1.58e-06)	(1.58e-06)	(1.57e-06)	(1.59e-06)	(1.58e-06)	(1.57e-06)	(1.59e-06)
Floor material (1=improved)		0.00940*					0.0152***
		(0.00531)					(0.00520)
Source of drinking water (1=improved)		-0.00365					-0.00255
		(0.00416)					(0.00413)
Sanitation (1=improved)		-0.00190					-0.00166
		(0.00514)					(0.00510)
Electricity access (1=Yes)		-0.0126					-0.00650
		(0.00802)					(0.00804)
Husband (partner) is employed		-0.00984					-0.00132
		(0.0172)					(0.0169)
Paternal education in groups (reference: No-education)							
Primary education		-0.00805*					-0.00494
		(0.00433)					(0.00433)
Secondary education		-0.0188***					-0.00966
		(0.00711)					(0.00715)
Above secondary level of education		-0.0218**					-0.0169

VARIABLES	(1) U5M	(2) U5M	(3) U5M	(4) U5M	(5) U5M	(6) U5M	(7) U5M
		(0.0107)					(0.0105)
Household size		-0.0189***					-0.0236***
		(0.000953)					(0.00113)
Rural (=1)	-0.00727	-0.0152**	-0.00704	-0.0128**	-0.00738	-0.00855	-0.0201***
	(0.00603)	(0.00774)	(0.00603)	(0.00619)	(0.00606)	(0.00602)	(0.00776)
Region Dummies (reference: Addis Ababa)							
Tigray	0.00806	0.00117	0.00678	0.00805	0.00790	0.0105	-0.000309
	(0.00943)	(0.0100)	(0.00946)	(0.00974)	(0.00946)	(0.00936)	(0.0103)
Afar	0.0432***	0.0435***	0.0439***	0.0352***	0.0416***	0.0458***	0.0353***
	(0.0106)	(0.0112)	(0.0106)	(0.0109)	(0.0106)	(0.0106)	(0.0115)
Amhara	0.0271***	0.0165	0.0259***	0.0247**	0.0270***	0.0320***	0.0155
	(0.00950)	(0.0101)	(0.00954)	(0.00968)	(0.00955)	(0.00944)	(0.0103)
Oromia	0.0203**	0.0212**	0.0194**	0.0192**	0.0202**	0.0236***	0.0154
	(0.00907)	(0.00971)	(0.00910)	(0.00909)	(0.00909)	(0.00903)	(0.00974)
Somali	0.0127	0.0175	0.0132	0.000746	0.0109	0.0140	0.000477
	(0.00998)	(0.0107)	(0.00997)	(0.0103)	(0.0100)	(0.00995)	(0.0109)
Benishangul Gumz	0.0348***	0.0273**	0.0332***	0.0335***	0.0349***	0.0379***	0.0229**
	(0.0103)	(0.0109)	(0.0104)	(0.0103)	(0.0104)	(0.0102)	(0.0108)
SNNP	0.0320***	0.0289***	0.0311***	0.0416***	0.0318***	0.0349***	0.0297***
	(0.00934)	(0.0100)	(0.00935)	(0.00998)	(0.00938)	(0.00928)	(0.0105)
Gambella	0.0447***	0.0498***	0.0445***	0.0557***	0.0449***	0.0432***	0.0540***
	(0.0107)	(0.0115)	(0.0107)	(0.0114)	(0.0107)	(0.0105)	(0.0120)
Harari	0.0231**	0.0241**	0.0224**	0.0151	0.0229**	0.0263***	0.0111
	(0.00991)	(0.0102)	(0.00993)	(0.0101)	(0.00993)	(0.00985)	(0.0104)
Dire Dawa	0.0227**	0.0173*	0.0219**	0.0181*	0.0229**	0.0235**	0.00873
	(0.0100)	(0.0104)	(0.0100)	(0.0102)	(0.0101)	(0.00998)	(0.0105)
Time (reference :2000)							
2005	-0.0125**	-0.00649	-0.00970*	-0.0197***	-0.0126**	-0.0144***	-0.0201***
	(0.00510)	(0.00652)	(0.00527)	(0.00536)	(0.00511)	(0.00506)	(0.00671)
2011	-0.0302***	-0.0159***	-0.0279***	-0.0286***	-0.0298***	-0.0347***	-0.0186***
	(0.00396)	(0.00414)	(0.00409)	(0.00413)	(0.00398)	(0.00392)	(0.00440)
Mother participating in a paid work (1=Yes)1.motherworking			0.00834**				0.00835**
			(0.00389)				(0.00388)
The mother visited health facility in last				-0.0138***			-0.0105***

VARIABLES	(1) U5M	(2) U5M	(3) U5M	(4) U5M	(5) U5M	(6) U5M	(7) U5M
12 months							
				(0.00393)			(0.00393)
The mother uses modern contraceptive method				-0.0158***			-0.0203***
				(0.00481)			(0.00487)
Religion (reference: Orthodox)							
Catholic				0.00564			0.0157
				(0.0209)			(0.0214)
Protestant				-0.0192***			-0.00844
				(0.00671)			(0.00671)
Muslim				0.00456			0.00595
				(0.00552)			(0.00553)
Traditional				-0.0103			-0.0120
				(0.0145)			(0.0145)
Beating is justified if wife leaves to her parents' home without telling husband/partner					-0.00172		-0.00115
					(0.00370)		(0.00368)
Age of the mother at first birth						-1.26e-05	7.48e-05
						(0.000616)	(0.000628)
Child has twin (1=Yes)						0.226***	0.221***
						(0.0192)	(0.0189)
Total number of children born from the same mother						0.000823	0.0116***
						(0.00121)	(0.00139)
Constant	0.0918***	0.169***	0.0886***	0.107***	0.0925***	0.0898***	0.160***
	(0.0109)	(0.0218)	(0.0110)	(0.0117)	(0.0111)	(0.0156)	(0.0251)
Observations	26,687	26,065	26,665	26,641	26,499	26,687	25,829
R-squared	0.011	0.030	0.011	0.012	0.011	0.024	0.050

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1