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Determinants of Maternal Delivery Place in Ethiopia

Ambaw Kassaw

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This is to certify that the thesis prepared by Ambaw Kassaw, entitled: Determinants of maternal delivery place in Ethiopia and submitted in partial fulfillment of the requirements for the Degree Master of Science in Statistics (BioStatistics) complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

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ABSTRACT

Determinants of maternal delivery place in Ethiopia

Ambaw Kassaw

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Place of delivery care services could save unnecessary severe complications and death among women during delivery. The objective of this study was to identify and study the effect of socio demographic factors that are likely to affect place of delivery care utilization in Ethiopia. The data used for the study were obtained from the 2011 Ethiopian Demographic and Health Survey (EDHS), a nationally representative survey of ever married women 15 to 49 years of age. In order to assess the relationship of social, economic and demographic factors on place of delivery care utilization. The study used logistic regression analysis. Odd ratio provides a meaningful way of interpreting the relationship between the independent variables and utilization of place of delivery care. Results of an estimated odds ratio of 1 indicate that the use of place of delivery care utilization is no different from the relationship in the reference category. If the estimated ratio is >1, the likelihood of the use of place of delivery care services is higher relative to the reference category. If the estimated odds ratio is <1 the probability of delivering at health facility is lower relative to the reference category. Results of a CI covering 1 imply that there is no effect of the factor under consideration. Otherwise, there is an effect of that variable. It was found that region, place of residence, mother's educational level, availability of television in the household, frequency of watching television, number of antenatal visits during pregnancy, and husband's educational level were significantly associated with place of delivery care.

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Abbreviations

WHO	World Health Organization
UNFPA	United Nation Population Fund, Programmers and Activities
MDG	Millennium Development Goal
ICPD	International Conference on Population and Development
UN	United Nations
TBAs	Traditional Birth Attendants
EDHS	Ethiopian Demographic and Health Survey
HEW	Health Extension Workers
MMR	Maternal Mortality Ratio
FMOH	Federal Ministry of Health
HSDP	Health Sector Development Plan
CSA	Central Statistical Agency
SNNPR	Southern Nations, Nationalities and People's Region
SNNP	Southern Nations, Nationalities and People's
WFS	World Fertility Survey

Table of content

List of tables

Chapter One

Introduction

1.1 Background of the study

The world now faces a global economic slowdown and a food security crisis: the economic slowdown will diminish the incomes of the poor; the food crisis will raise the number of hungry people in the world and push millions people into poverty. The poor are not only those with the lowest incomes but also those who are the most deprived of health, education and other aspects of human well-being. Most maternal deaths do occur in poor countries and it is well known that poor countries are also the ones with highest maternal mortality rates (Van Lerberghe and De Brouwere, 2001).

Maternal health has emerged as global priority because of a great gap in the status of mother's well being between the rich and the poor countries. According to WHO (2008), maternal health refers to the health of women during pregnancy, childbirth and the postpartum period. In rich nations, where women have access to basic health care, giving birth is a positive and fulfilling experience. On the other hand, for many women in poor countries it is associated with suffering, ill health and even death.

Internationally, increasing attention given to maternal health has been concentrated in reducing maternal mortality. The tragedy of not preventing these avoidable or treatable deaths resulted in 536,000 maternal deaths worldwide in 2005 (WHO, 2007). Developing regions accounted for 99 percent (533,000) of these deaths, with sub-Saharan Africa and Southern Asia accounting for 86 percent of them. Put another way, every minute of each year a woman dies from complications of

pregnancy, abortion attempts and childbirth (UNFPA, 2004). Millions more women survive but suffer from illness and disability related to pregnancy and childbirth.

WHO (2007) has summarized three crucial factors underlying maternal deaths. Firstly, lack of access and utilization of essential obstetric services. There is a negative association between maternal mortality rates and maternal health care utilization. WHO (2007) estimates suggest that 88 to 98 percent of all pregnancy-related deaths are avoidable if all women would have access to effective reproductive health care services (Kunst and Houweling, 2001). Secondly, women have low social status in developing countries. The low status of women can limit their access to economic resources and basic education, the impact is that they have limited ability to make decisions, including a decision related to their health and nutrition. Thirdly, too much physical work together with poor diet also contributes to poor maternal health outcomes.

Improving maternal health and reducing maternal mortality have been the main concerns of several international summits and conferences. It began with the international conference on safe motherhood held in 1987 and continued through ICPD 1994 and again through ICPD+5 (five-year review of the 1994ICPD) and the Millennium Development Goals. The first conference ended with a declaration calling for a reduction in maternal mortality at least half by the year 2000. The ICPD set a goal of reducing maternal mortality to one half of the 1990 levels by 2000 and a further one-half reduction by 2015 (UNFPA, 2004). The Millennium Summit in 2000 calls for a 75 percent reduction by 2015 in the maternal mortality ratio from 1990 levels (UN, 2008). However as the deadline approached, these hopes had not been met yet, the world was nowhere near achieving this objective,

and it was not even certain that global maternal mortality levels had declined in the past decade to any significant degree (Shiffman, 2003).

Reduction of maternal mortality has been a common goal addressed at several international conferences in particular, the Nairobi Safe Motherhood Conference in 1987, the World Summit for Children in 1990, the International Conference on Population and Development in 1994 and the Fourth World Conference on Women in 1995 (Cham, 2003). Safe Motherhood Initiative was to draw attention to the dimensions on the consequences of poor maternal health in developing countries, and to mobilize action to address the high rates of deaths and disability (UNFPA, 2005). Safe Motherhood Strategies (SMS) were developed based on pregnancy, antenatal, delivery and the postpartum periods. The specific activities include the provision of antenatal care, skilled assistance for normal deliveries, appropriate referral for women with obstetric complications, postnatal care, family planning and other reproductive health services. The four basic principles or pillars of the Safe Motherhood Strategy are:

1. Family planning: providing information and services.

2. Antenatal care: early detection and providing appropriate care and treatment.

3. Clean and safe delivery: providing trained skilled birth attendants and equipment.

4. Emergency obstetric care: providing basic and essential obstetric care.

In addition the above activities, training of traditional birth attendants (TBAs), community health workers and provision of clean delivery kits to promote clean home deliveries and strengthening linkages between different levels of health

facilities and the community are also considered key strategies to reduce maternal mortality.

The utilization of maternal health care is one of the important factors to reduce the incidence of maternal mortality. United Nations reported that maternal health care from developing countries are as follow: the number of pregnant women who receive at least one antenatal care is approximately 74 percent in 2005 (UN, 2008); 40 percent of deliveries take place in health facilities (UNFPA, 2004); and skilled health personnel assist nearly 61 percent of births in 2006 (UN, 2008). Obviously, the data indicate that the national governments' commitment to maternal health care have not reached the levels required to make strong impact on mortality rates. Many existing interventions have been found to be ineffective in preventing maternal deaths. Laws and regulations in many countries sometimes impede health care policies (mostly in specific areas such as sexuality education and access of adolescents to reproductive health information and services).

Increasing deliveries assisted by skilled attendance is one of the indicators of progress towards MDG. The proportion of births in low- and middle-income countries assisted by a skilled birth attendant increased from 47% in 1990 to 61% in 2006 (WHO, 2008). The regions with the lowest proportions of skilled health attendants at birth were eastern Africa (34%), western Africa (41%) and south-central Asia (47%), which also had the highest numbers of maternal deaths. The current number of skilled attendants is critically insufficient. An estimated 700,000 midwives are needed worldwide to ensure universal coverage with maternity care, but there is currently a 50% shortfall. In addition, 47,000 doctors with obstetric skills are required, particularly in rural areas. Worldwide, 4.3 million health workers are lacking (WHO, 2007).

Proper care during pregnancy and delivery is important for the health of both the mother and the baby, and is the fifth Millennium Development Goal (MDG). Access to proper medical attention and hygienic conditions during delivery can reduce the risk of complications and infections that may lead to death or serious illness for the mother and/or baby (Van Lerberghe and van De Brouwere, 2001). According to (CSA, 2011) the 2011 EDHS, 10 percent of women reported that their most recent live birth in the last five years was delivered by a health professional. Ten percent of births were delivered in a health facility, a doubling of the level reported in the 2005 EDHS (CSA, 2005). Fifty-one percent of births to urban mothers were attended by a health professional and 50 percent were delivered in a health facility, compared with 5 percent and 4 percent, respectively, of births to rural women. Mothers residing in Addis Ababa are the most likely to be attended to at delivery by a health professional (84 percent) and the most likely to deliver in a health facility (82 percent) compared with mothers of other regions. Mothers' educational status is highly correlated with whether delivery is assisted by a health professional and whether the birth is delivered in a health facility. For example, 5 percent of births to mothers with no education were attended by a health professional and delivered in a health facility compared with between 70 and 72 percent of births to mothers with some secondary education. Less than one percent of women were attended by a HEW at delivery.

1.2 Statement of the problem

Despite the fact that maternal place of delivery care utilization is essential for further improvement of maternal and child health, little is known about the current magnitude of use and factors influencing the use of these services in Ethiopia. This study therefore aims to fill this gap using data from the 2011 Ethiopia Demographic and Health Survey (EDHS).

1.3 Objective of the study

The main objective of this study is to identify major socio demographic and health related factors that are likely to affect maternal delivery care utilization by place of delivery.

1.4 Significance of the study

It is hoped that the study can provide information about mothers who give birth through the concerned bodies like HEW, hospitals and any health institutions.

Chapter Two

Literature review

Several studies have investigated maternal health care (antenatal, delivery and neonatal) using different methods in different areas. Here are some literatures related to this study.

Globally, among 132,352,900 births, it is estimated that 34% of mothers deliver with no skilled attendant; this means there are 45 million births occurring at home without skilled health personnel each year. Skilled attendants assist in more than 99% of births in developed countries compared with 62% in developing countries. In five countries including Ethiopia the percentage drops to less than 20% (WHO, 2005).

Skilled attendance at delivery is one of the key indicators to reflect progress towards the Millennium Development Goal of improving maternal health. The agreement set the goal of 40% of all births to be assisted by a skilled attendant by 2005, with 50% coverage by 2010 and 60% by 2015 among countries with very high maternal mortality. Globally, the goal is to have 80% of all births assisted by skilled attendants by 2005, 85% by 2010 and 90% by 2015 (Stanton et al, 2007).

A study from south India showed that assistance during delivery can reduce the risk of obstructed labor and it is highly associated with the place of delivery (Navaneetham and Dharmalingam, 2002). AbouZahr (2003) discussed the role of assisted skilled birth attendants in preventing direct and indirect cause of maternal deaths such as, infection, shock, blood loss, convulsions, and surgical procedures, such as caesarean delivery. Maternal mortality and morbidity are directly and indirectly related to societal and cultural factors that impact women's health and

their access to services. Thus, lack of access and control over resources, limited educational opportunities, poor nutrition, and lack of decision-making contribute significantly to adverse pregnancy related outcomes. Review of the international literature also emphasizes factors like cultural beliefs, socio-demographic status, women's autonomy, economic conditions, physical and financial accessibility, disease pattern and health service issues to be important determinants of the use of maternal health care services (Babar et al, 2004, AbouZahr, 2003).

Shariff and Singh (2002) have pointed out that the low utilization of maternity services seems to be due to low levels of household income, high illiteracy and ignorance, and a host of traditional factors in India. A similar study in Pakistan described poor socio-economic status, lack of physical accessibility, cultural beliefs and perceptions, low literacy level of the mothers and large family size as the leading causes of poor utilization of primary health care services (Babar et al, 2004). A study from Ethiopia observed that the use of maternal health services can be influenced by the socio demographic characteristics of women, the cultural context, and the accessibility to these services (Yared, 2003).

A study of analysis of choice of delivery location in India showed that maternal and paternal education, and scheduled caste status were the predisposing factors that determined the choice of private facilities, public and home deliveries (Thind et al, 2008). A study from Pakistan showed that family size, parity, educational status and occupation of the head of the family were also associated with health seeking behavior in addition to age, gender and marital status (Babar et al, 2004). A study from rural Tanzania identified that ethnicity, gender of the household head, mother's education, mother's age at child birth, socio-economic and quality of services status were important independent factors in determining the choice of delivery place sudden onset of labour or short labour were affecting decisions

towards selecting the delivery place. Selecting health facility for delivery was perceived to be more desirable for prolonged labour (Mrisho et al, 2007).

In summary, the above studies have identified that the main determinants for low utilization of maternal health care services include maternal education, ethnicity, gender of the household head, mother's education, mother's age at child birth, socio-economic status, parity, accessibility and quality of health service, decision making power and experience of previous obstructed labour.

A review of the literature suggests that in developing countries, the use of modern health care such as maternal health services can be influenced by the sociodemographic characteristics of women, the cultural context, and the accessibility of these services.

A number of sociodemographic characteristics of the individual affect the underlying tendency to seek care (Addai, 2000). In this regard, good examples are maternal age and parity, which have been examined as determinants of health care use repeatedly (Adekunle et al., 1990; Celik and Hotchkiss, 2000; Leslie and Gupta, 1989). The greater confidence and experience of the older and higher parity women, together with greater responsibilities within the household and for child care, have been suggested as explanatory factors for their tendency to use services less frequently (Kwast and Liff, 1988). Maternal education has also been shown repeatedly to be positively associated with the utilization of maternity care services (Addai, 2000; Addai, 1998; Akin and Munevver, 1996; Becker et al., 1993; Celik and Hotchkiss, 2000; Ferdnandez, 1984; Stewart and Sommerfelt, 1991). Although, in general, women in higher socioeconomic groups tend to exhibit patterns of more frequent use of maternal health services than women in the lower

socioeconomic groups, factors such as education appear to be important mediators (Addai, 2000; Addai, 1998; Leslie and Gupta, 1989).

Another important factor in the utilization of maternity care services, especially in Africa, is the cultural background of the woman (Leslie and Gupta, 1989; Pelto, 1987). The cultural perspective on the use of maternal health services suggests that medical need is determined not only by the presence of physical disease but also by cultural perception of illness (Addai, 2000). In most African rural communities, maternal health services coexist with indigenous health care services; therefore, women must choose between the options (Addai, 2000). The use of modern health services in such a context is often influenced by individual perceptions of the efficacy of modern health services and the religious beliefs of individual women (Adetunji, 1991). Moreover, in many parts of Africa, women's decisionmaking power is extremely limited, particularly in matters of reproduction and sexuality. In this regard, decisions about maternal care are often made by husbands or other family members (WHO, 1998). Availability of women's time is also important. In developing countries, women spend more time on their multiple responsibilities for care of children, collecting water or fuel, cooking, cleaning, growing food, and trade than on their own health (World Bank, 1994a). Accessibility of health services has been shown to be an important determinant of utilization of health services in developing countries. In most rural areas in Africa, one in three women live more than five kilometers from the nearest health facility (World Bank, 1994b). The scarcity of vehicles, especially in remote areas, and poor road conditions can make it extremely difficult for women to reach even relatively nearby facilities. Walking is the primary mode of transportation, even for women in labor (Williams et al., 1985; World Bank, 1994b). In rural Tanzania, for example, 84 percent of women who gave birth at home intended to deliver at a

health facility but did not due to distance and lack of transportation (Bicego et al., 1997). Fees reduce women's use of maternal health services and keep millions of women from having hospital-based deliveries or from seeking care even when complications arise. Even when formal fees are low or nonexistent, there may be informal fees or other costs that pose significant barriers to women's use of services. These may include costs of transportation, drugs, food, or lodging for the woman or for family members who help care for her in the hospital (Gertler and van der Gaag, 1988; Gertler et al., 1988).

Amongst the maternal characteristics, education of women has been found to have the strongest association with the use of maternal health care services. In Peru for example, formal education of women influences the use of maternal health care services. Results from both the cross-sectional and fixed-effects model, controlling for service availability and the socioeconomic status of the household, confirmed the importance of maternal education on the utilization of both prenatal care and delivery assistance (Elo, 1992). Similarly, in Thailand, one analysis showed that maternal education exerts a significant influence on the use of maternal health care services; the odds of using prenatal care and formal delivery assistance is much greater for women with primary schooling, compared to women with zero years of schooling (Raghupathy, 1996).

Educated mothers are considered to have a greater awareness of the existence of maternal health care services and benefited in using such services. Educated mothers are likely to have better knowledge and information on modern medical treatment and have greater capacity to recognize specific illnesses. As education empowers women, they have greater confidence and capability to make decision to use modern health care services for themselves and for the children (Caldwell, 1979; Schultz, 1984). Education also enables women to take personal

responsibility for their own health and the health of their children. Finally, schooling reflects a higher standard of living and access to financial and other resources, because better educated women are more likely to marry wealthier men or their have increased earnings themselves (Schultz, 1984).

There is also evidence indicating that education alone may not be sufficient to improve health-care-seeking behavior. For example, Kyomuhendo (2003) found that despite a favorable and enabling policy environment, universal primary education and decentralization of health services, there has not been an increase in the utilization of emergency obstetric care by women in Uganda, because women's care-seeking behavior was not the result of individual preferences or choices but it was conditioned by community poverty, norms and tradition.

Husband's education also reflects tastes and preferences for health-care utilization. The husband's attitudes towards modern care could, for example, influence the wife's decision of whether or not to seek modern health-care services. It has been suggested that men with higher educational attainment may play a more important role in child-care decisions than men with less schooling (Caldwell, 1990).

A study in India reported that matriculate education has the largest and statistically significant impact on the probability of health care use. It increases the probability of pre and post natal care use by 10 percent and 8 percent respectively and the probability of the use of trained help at the time of delivery by 7 percent (Shariff and Singh, 2002).

Existing research on health outcomes in developing countries has shown the important role of the media in disseminating information on health related issues. Three sources of information are usually used: radio, television and newspapers and magazines.

Women's exposure to information through the radio, television and newspaper significantly increases the utilization rates for all services in India (Shariff and Singh, 2002). There is a 5 percent increase in the probability of the use of natal care for a woman who frequently listened to the radio compared to a woman who does not. Moreover, a study by Obermeyer (1993) in Morocco and Tunisia indicated that watching television weekly is associated with an increase in the likelihood of both prenatal care and hospital delivery.

Autonomy has been defined as the capacity to manipulate one's personal environment through control over resources and information in order to make decisions about one's own concerns or about close family members. Women's autonomy thus can be conceptualized as their ability to determine events in their lives, even though men and other women may be opposed to their wishes (Bloom et al, 2001). The influence of women's autonomy on the use of health care appears to be as important as other known determinants such as education. Dimensions of autonomy such as freedom of movement, decision making power and control over finance can exert a strong influence over service use and service choice in South Asian setting (Bloom et al, 1998 cited in Kausar et al, 1999). In a North Indian City, women's autonomy, as measured by the extent of a women's freedom of movement, appears to be a major determinant of maternal health care utilization among the poor to middle income women (Bloom et al, 2001).

Dependence on men for economic survival has been a principal barrier to women's control over their reproductive behavior in developing countries. Empowering women with more economic participation and control in their households and communities might be the key to their achieving control over their own reproductive health.

Employment can increase women's economic autonomy and reproductive health status because it raises awareness and provides new ideas, behavior and opportunities through interaction with other people outside the home and community (Sharma et al, 2007).

A study in Kenya (Magadi et al, 2000) reported that the antenatal care visits tend to start earlier for women in paid employment. They are likely to have greater knowledge about pregnancy and childbirth due to freedom of movement outside household. They also tend to seek information on services available for pregnancy care during work.

Employment may not necessarily be associated with greater use of maternal health care, like in Nepal (Sharma et al, 2007), because non-working women may be better off than working women. In the context of developing countries, women's work is largely poverty induced and is likely to have a negative impact on utilization of maternal health services.

The husband's occupation can represent family income as well as social status, and it is well established that increased income has a positive effect on the utilization of modern health care services (Elo, 1992). Differential utilization of health services by different occupational groups also depicts occupation as one of predisposing factors. An empirical research by Paul and Rumsey (2002) in rural Bangladesh showed result that fathers employed in non-farm occupations chose trained personnel for delivery more frequently than fathers who were farmers or members of other educations. Furthermore, another study in Bangladesh reported that women whose husbands work in business or services are most likely to be the users of professional healthcare services to treat their complications (Chakraborty et al, 2003).

Since older and younger women have different experience and influence, their behavior on seeking health care are also vary. Commonly, younger women are more likely to utilize modern health care facilities than older women, as they are likely to have greater exposure and knowledge to modern health care, also more access to education. Older women, on the other hand, have accumulated knowledge on maternal health care and therefore likely to have more confidence about pregnancy and childbirth or they may be less comfortable with modern medicine and more reluctant to take advantage of available services; consequently, they may give less importance to obtain institutional care (Raghupathy, 1996). In contrast, experience and skills acquired by older women should have a positive influence on the use of health services.

One study in Nepal (Sharma et al, 2007) gave result that women over the age 35 are less likely to utilize prenatal care but more likely to utilize delivery and postnatal care. However, a study in Bangladesh indicated that type of assistance utilized at delivery does not differ significantly with the age of the mother (Paul and Rumsey, 2002). In Philippines, older women tend to have fewer traditional visits both in urban and rural areas and to increase their private visits in urban areas (Wong et al, 1987).

Place of residence can also be an important determinant of the use of modern health care resources for childbirth. A higher proportion of births in urban areas occur in modern health care facilities compared to rural areas (Paul and Rumsey, 2002). A study in Morocco also indicated that residence is the strongest predictor of use of maternal health care, with urban women two or three times more likely to use health services (Obermeyer, 1993). In a study in Philippines reported urban and rural women differed significantly in the types of prenatal care most frequently used. For the urban women the most frequently used type of care tended to be

modern public (40.2%), while rural women frequently used traditional practitioners (45%). Overall, about 38% of the rural and 59% of the urban women had modern prenatal medical care (Wong et al, 1987).

The importance of place of residence in determining women's use of maternal health care can be explained through the availability of health facilities. It is undeniable that generally, medical facilities are more ready accessible in urban than rural are. In addition, urban women tend to be more educated and therefore, have greater knowledge about the benefits of maternal health care.

With respect to birth order, several studies show a strong negative association between birth order and the use of health care services. One study in Turkey (Celik and Hotchkiss, 2000) showed that women who delivered their first child were found to be significantly more likely to use prenatal care and trained assistance during the birth delivery than women in the higher order. Another study in urban areas Philippines appeared that the probability of choosing as most frequent either public or private modern care instead of traditional care decreases as the number of children aged zero to six years old increases (Wong et al, 1987).

There are perhaps, three possible explanations for this. Firstly, women with first child pregnancy were more cautious about their pregnancies and therefore sought out trained professional. Secondly, as the number of children has borne increases, women may tend to believe that modern health care is not as necessary and tend to rely more on her past experiences and knowledge from the accumulated previous. Thirdly, a higher birth order suggests a greater family size and hence lower resources (both time and money) available to seek formal healthcare.

In Ethiopia, studies addressing the factors influencing the utilization of maternity care services are scant. The few studies that do exist focused predominantly on

urban areas and have identified some important determinants of use of maternity care services in the country. Kwast and Liff (1988), in their study of maternal mortality in Addis Ababa, showed that women who did not receive maternity care were often poor, illiterate, and unmarried, with limited knowledge of maternity care services. The study also showed that the risk of nonattendance was higher for pregnant women who were first pregnant between the ages of 10 and 18. In a nationally representative sample survey in Ethiopia, receipt of maternity care was found to vary by age, residence, and other sociodemographic factors (CSA, 1993). Another study in Addis Ababa showed that lack of time, absence of illness, and lack of awareness are the major reasons for nonattendance for antenatal care (Mesganaw et al, 1990). Mengistu and James (1996), in their study in the Arsi Zone of central Ethiopia, found maternal age, parity, lack of time, education, marital status, and women's economic status to be significant predictors of utilization of maternity care. A study in Yirgalem Town and in the surrounding Southern Nations, Nationalities, and People's Region (SNNPR) of Ethiopia showed that women's education, inadequate household income, and unwanted pregnancy were important predictors of antenatal care utilization (Belay, 1997). A large-scale community and family survey in SNNPR concluded that although a number of sociodemographic factors are important in urban areas, they are of less relevance in the rural part of the study area. Socio demographic factors including parity, age, and education appeared to influence the use of maternity care services in urban areas. In contrast, distance and travel time were identified as important factors in the rural parts of the country (Mekonnen, 1998).

Chapter Three

Data and methodology

3.1 Data source

The analysis in this study uses data from the 2011 Ethiopian Demographic and Health Survey (EDHS) conducted by the Central Statistical Agency (CSA) under the auspices of the Ministry of Health from September 2010 through June 2011 with a nationally representative sample of nearly 18,500 households. In particular, this study is based on a nationally representative sample of 16,515 women of age 15-49 who had at least one child under age five at the time of survey.

3.2 Variables of the study

3.2.1 The Response variable

In this study the response variable, Y, is place of delivery care. Place of delivery care was categorized as health facility if a mother gave birth at a health facility (public and private), or if mother gave birth at home.

$$Y_i = \begin{cases} 1 & if\ delivery\ took\ place\ in\ a\ health\ facility \\ 0 & at\ home \end{cases} \qquad i = 1,2,\dots\dots\dots,n$$

3.2.2 Explanatory variables

The explanatory variables that were considered in this study were mother's age, antenatal care visits during pregnancy, place of residence, region, mother's educational level, husband's educational level, wealth index, availability of television in the household, frequency of watching television, and religion. These

variables were categorized as follows: age of mother's as 15-19 years, 20-34 years and 35-49 years. Antenatal care visits was classified as no antenatal visit, 1-3 visits and 4 and more visits. Residence was categorized as rural and urban. The classification of region was taken as nine regions and two city administrations. These are: Tigray, Affar, Amhara, Oromiya, Somali, Benishangul-Gumuz, SNNP, Gambela, Harari, Addis Ababa and Dire-Dawa. Mother's education, and husband's education was categorized as no education, primary, secondary and higher. Based on the wealth status of mother's wealth index was categorized as poorest, poorer, middle, rich and richest. Religion was categorized as Coptic orthodox, Protestant, Catholic, Muslim, and traditional believers. If a household has no television at home the response was categorized as "No" and "Yes" otherwise. Finally, frequency of watching television was classified as not at all, once or not at all (irregularly), two or more days a week (irregularly). (See Appendix A).

3.3 Methodology

3.3.1 Logistic regression analysis

Logistic regression analysis consists of fitting a linear logistic model to an observed proportion or rate in order to measure the relationship between the outcome variable and one or more explanatory variables. It is one of the generalized linear models that encompasses categorical response data analysis. A binary response variable is coded as two categories by 1 and 0. Commonly the generic terms success and failure are used for these outcomes.

This study used logistic regression to examine the association between selected maternal characteristics and place of delivery care.

3.3.2 Model

Logistic regression can handle multiple predictors. The multiple logistic regression models has the form

$$\text{logit } \pi(x) = \text{logit}[P(y = 1)] = \alpha + \beta_1 x_1 + \ldots\ldots + \beta_k x_k \qquad (3.1)$$

Where

$$\pi(x) = P(y = 1/x = x) = \frac{\exp(\alpha + \beta_1 x_1 + \ldots\ldots + \beta_k x_k)}{1 + \exp(\alpha + \beta_1 x_1 + \ldots\ldots + \beta_k x_k} \qquad (3.2)$$

3.3.3 Parameter estimation

Logistic regression uses the Maximum Likelihood Estimation method to estimate the model coefficients and other statistics. This method yields values of α and β which maximize the probability of obtaining the observed set of data. Conceptually, it works like this: First construct a likelihood function which expresses the probability of the observed data as a function of the unknown parameters α and β.

In the univariate case, the contribution to the likelihood function for a given value of the predictor X, is $P(Y = 1|x)^{y} * P(Y = 0 | x)^{1-y}$

Thus when Y = 1, the contribution is: $P(Y = 1| x)$

When Y = 0, the contribution is: $P(Y = 0 | x)$

Since the sample observations are assumed to be independent, the likelihood function for the dataset is just the product of the individual contributions:

$$L = \prod P(Y = 1 | x)^{y} * P(Y = 0 | x)^{1-y} \quad (3.3)$$

A more tractable version of this function is obtained by taking the natural logarithm of the likelihood function, called the Log Likelihood function:

$$LL = \sum y Log[P(Y = 1 | x)] + (1 - y) Log[P(Y = 0 | x)] \quad (3.4)$$

To find the values of the parameters that maximize the above function, we differentiate this function with respect to α and β and set the two resulting expressions to zero. An iterative method is used to solve the equations and the resulting values of α and β are called the maximum likelihood estimates of those parameters. The same approach is used in the multiple predictor case where we would have (p+1) equations corresponding to the p predictors and the constant α.

3.3.4 Statistical tests and assessing model fit

Once we fitted a logistic regression model, the first step is to assess the significance of the overall model with k coefficients for the predictors included. A logistic model is said to be provide a better fit to the data if it demonstrates an improvement over the intercept only model (also called the null model, which has no predictors). Such an improvement is examined by inferential and descriptive statistics. The inferential statistics includes three tests: the likelihood ratio test, score and Wald test. The likelihood test is a test based on the difference in deviances: the deviance without any predictor in the model (or the intercept only model) minus the deviance with all predictors in the model. The score test is based on the distribution of the k derivatives of the fitted model's likelihood function with regard to all parameters. The Wald test is obtained from a vector matrix calculation that involves the parameter vector, its transpose, and the inverse of its variance matrix (Hosmer-Lemeshow, 2000). All three test statistics are distributed

as a chi squares with degrees of freedom equal to the number of predictors. Likelihood Ratio Test which tests the null hypothesis

H_0: $\beta_1 = \beta_2 \ldots\ldots = \beta_k = 0$

The test statistic is given by:

G = -2 [LL (constant only model) - LL (chosen model with k predictors)]

Under the null hypothesis G has a Chi-square distribution with (k-1) degrees of freedom. A small p-value leads to rejecting H_0 and the conclusion that at least one (or more) of the k coefficients are different from zero.

With regard to statistical tests of individual predictors, individual parameters are tested by the likelihood ratio test, the Wald statistics, or score test. The likelihood ration test is a test based on the difference in deviances: the deviance without the predictor in the model minus the deviance with the predictor in the model. The Wald statistics is formed from the ratio of the estimated slope parameter over its standard error.

The Pearson chi square and deviance based goodness of fit statistics are computed by different packages. Insignificant statistics imply a good fit of the model. Only when these statistics are calculated from covariate patterns and the numbers of observations in each covariate pattern is mostly greater than one, can they be regarded as indexes of goodness of fit (Hosmer-Lemeshow, 2000; McCullagh and Nelder, 1989).

The Hosmer-Lemeshow statistic is a Pearson chi square statistic, calculated from a 2xg table of observed and expected frequencies, where g is the number of groups formed from the estimated probabilities. Ideally, each group should have an equal number of observations. There are limitations with Hosmer-Lemeshow test. First,

the test is conservative, lacking statistical power in the certain cases to detect a model's poor fit. Second, even when the test is significant, indicating that does not fit a model well, it does not shed light on where and why data are not well fitted by the model. According to (Hosmer-Lemeshow, 2000), the Hosmer-Lemshow statistic is too conservative to reject the null hypothesis when groups are fewer than six or expected cell frequencies are less than five.

Akaike information criterion (AIC) or Schwarz criterion (SC) is another way of measuring goodness of fit. As summary,

1. **Pearson Goodness of Fit Chi-Square test:** The null hypothesis is that the chosen model fits the data. The test statistic computes the overall difference between the observed probabilities and those estimated from the fitted model. Unlike most tests of significance, we want this test to be non significant (large p-value desired) to indicate that our model is a good fit. This means is that the difference between the expected values using this model and the actual values is non-significant.
2. **Deviance Test:** The deviance statistic is calculated as the sum of the differences between the log likelihoods of the saturated model (which has as many coefficients as observations in the dataset) and the chosen model, for all the observations in the sample. It follows a Chi-square distribution with df = difference in the number of parameters in the two models. The null hypothesis sets the coefficients that are in the saturated model but not in the fitted model, to zero. A large p-value indicates that none of the excluded variables is significant; that the fitted model is as good as the saturated model.
3. **Hosmer-Lemeshow Test:** Considered one of the best tests of fit, this approach divides the range of probability values into groups based on covariate patterns and compares the observed and expected counts within these groups using a Chi-square

statistic. The smaller the differences in expected and observed counts, the smaller the overall variance and thus the test statistic value. Therefore, a large p value indicates a good fit.

4 **Information Criteria:** These are relatively new tests and are comparative in nature. There are two main types of information criteria: Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC). All things being equal, smaller values of the criteria indicate a better fitting model.

- Akaike Information Criterion (AIC)

  $$\text{AIC} = \frac{-2(\text{LL}-\text{k})}{n},$$ k=number of predictors, n= sample size

- Bayesian Information Criterion (BIC)

  $$\text{BIC} = -2 * \text{LL} + \log(\text{n}) * \text{k}$$ k=number of predictors, n= sample size

3.3.5 Validation of predicted probabilities

As explained earlier, the binary logistic regression predicts the logit of an event outcome by a set of predictors. Because the logit is the natural log of the odds, or probability/ (1-probablity), it can be transformed back to the probability scale and become the predicted result of logistic regression. The predicted probabilities can be revalidated with the actual outcome to determine if high probabilities are indeed associated events and low probabilities with non events. The degree to which predicted probabilities match with actual outcome is expressed a measure of association.

There are four measures of association: Tau-α, Gamma, Somers's D statistic, and C statistic. The Tau-α statistic is Kendall's rank order correlation coefficient

without adjustments for ties. The Gamma statistic is based on Kendall's coefficient but adjusts for ties. Gamma is more useful and appropriate than Tau-α when there are ties on both outcomes and predicted probabilities. Proc logistic computes the following four indices of rank correlation for assessing the predictive ability of a model:

$$c = \left(n_c + 0.5(t - n_c - n_d)\right)/_t$$

$$Somers'D = (n_c - n_d)/_t$$

$$Goodman - Kruskal\ Gamma = (n_c - n_d)/(n_c + n_d)$$

$$Kendall's\ Tau - a = (n_c - n_d)/(0.5N(N-1))$$

3.3.6 Model diagnostic checking

The purposes of diagnostic analyses are twofold: first, to identify potential outliers; second, to understand the model's poor fit to certain observations. These statistics should be computed from covariate patterns. Only when the number of unique covariate patterns is much smaller than the number of observations in the examination of diagnostic statistics is meaningful.

Diagnostic statistics available from statistical software include Pearson and deviance residuals, change in the in the Pearson chi square statistic and change in the deviance, the change in parameter estimates due to particular covariate pattern deleted.

The Pearson residual and the deviance residual are components of the Pearson chi square statistic and the deviance respectively. A “large” value of either statistic is indicative poorly explained covariate pattern. Because large is a relative term, researchers must rely on their own judgment in deciding if a particular residual is large, compared to other residual. For this reason, the Pearson residual and the deviance residual are not informative as their respective changes. The change in Pearson chi square is defined as the difference in Pearson chi square due to the deletion of particular covariate pattern. A large value once again indicates that the corresponding covariate pattern contribute highly to the disagreement between the data and predicted probabilities.

DFBETAs- assess the effect of an individual observation on the estimated parameter of the fitted model. A DFBETAs diagnostic is computed for each observation for each parameter estimate. It is the standardized difference in the parameter estimate due to deleting the corresponding observation. The DFBETAs are useful in detecting observations that causes instability in the selected coefficients.

Leverage (hat matrix) value measures the influence of a point on the fit of regression.The centered leverage ranges from 0 (no influence on the fit) to (n-1)/n or it is from 0 to1.

Cook’s distance (D) is a measure of how much the residual of all cases would change if a particular case were excluded from the calculation of the regression coefficients. A large Cook’s distance indicates that excluding a case from computation of the regression statistics changes the coefficients substantially.

Chapter Four

Results and Discussion

4.1 Descriptive data analysis

Table 4.1 shows place of delivery care of ever-married women aged 15-49 years who had a live birth in the five years preceding the survey. So this analysis is based on a sample of 7,182 women for place of delivery care. As seen from the table, of the total of 7,182 women in the sample, 16.2 % deliveries took place at health facilities. The remaining 83.8 % deliveries took place at home.

Table 4.1. Results of descriptive analysis

		Place of delivery care				
Characteristics	Categories	Health facility	percentage	Home	Percentage	Total
Mother's age	15-19	48	13.52	307	86.48	355
	20-34	937	18.62	4094	81.38	5031
	35-49	181	10.1	1615	89.9	1796
Region	Tigray	93	12	682	88	775
	Afar	39	5.67	648	94.33	687
	Amhara	75	8.53	804	91.47	879
	Oromiya	97	9.3	946	90.7	1043
	Somali	47	9.1	470	90.9	517
	Benishangule Gumuz	49	7.96	566	92.04	615

	SNNP	65	6.73	901	93.27	966
	Gambela	102	18.9	439	81.1	541
	Harari	154	37.3	259	62.7	413
	Addis Ababa	265	83.6	52	16.4	317
	Dire Dawa	180	41.96	249	58.04	429
Place of residence	Urban	875	62.54	524	37.46	1399
	Rural	291	5.03	5492	94.97	5783
Mother's educational level	No education	336	6.97	4486	93.03	4822
	Primary education	478	24.91	1441	75.09	1919
	Secondary education	219	76.31	68	23.69	287
	Higher	133	86.36	21	13.64	154
Household has Television	No	531	8.41	5786	91.59	6317
	Yes	635	73.41	230	26.59	865
Religion	Orthodox	594	24.04	1877	75.96	2471
	Catholic	12	15.58	65	84.42	77
	Protestant	160	11.5	1231	88.5	1391
	Muslim	398	12.49	2788	87.51	3186
	Traditional	2	3.5	55	96.5	57
Frequency of watching Television	Not at all	290	5.96	4573	84.04	4863
	Once or not in week (irr.)	294	20.78	11.21	79.22	1415
	Two or more days a week (irr.)	582	64.38	322	35.62	904

Wealth index	Poorest	75	3.58	2021	96.42	2096
	Poorer	49	3.93	1197	96.07	1246
	Middle	47	4.07	1107	95.93	1154
	Rich	99	8.65	1045	91.35	1144
	Richest	896	58.11	646	41.89	1542
Number of antenatal visits during pregnancy	No antenatal visit	166	4.2	3797	95.8	3963
	1-3	269	16.35	1376	83.65	1645
	4+	731	46.44	843	53.56	1574
Husband's/partner's educational level	No education	193	5.31	3439	94.69	3632
	Primary education	461	17.4	2189	82.6	2650
	Secondary education	296	52.86	264	47.14	560
	Higher	216	63.53	124	36.47	340
Total		1166	16.2	6016	83.8	7182

The proportion of place of delivery care in age group 15-19 has 13.5% usage in health facilities. The women in age group 20-34 form the highest proportion (18.62%) of deliveries took place in the health facilities. Women aged 35 and above tend to have lower percentage (10.1%) in using health facilities.

It can be seen from the proportion of women of all regions in the table that women from Addis Ababa, Dire Dawa, Harari and Gambela used health facilities more than women from Tigray region. Those regions which had lower proportion of deliveries in health facilities were Afar (5.67%), SNNP (6.73%), Benishangul Gumuz (7.96%), Amhara (8.53), Somali (9.1%), and Oromiya (9.3%).

The proportion of urban women who delivered at health facilities was 62.54 %, while rural women only 5 %.

The percentage of women according to place of delivery care and women's educational level can be seen from the table. The proportions of women of all educational level were more likely to use health facilities than less educated women. That means, of those women who went to health facilities for delivery, the better educated ones used modern maternal delivery care more than those women with no education. It appeared that there was a consistent increase in the percentage of women who took delivery at health facilities with an increase in women's educational level.

Women who had no television in the household gave less attention to deliver their babies in the health facilities. About 8.41 % women who had no television in the household delivered in the health facilities. Women who had television in the household took their delivery in the health facilities (73.41%).

Place of delivery care was different for different religion types. About 24.04% of women who went health facilities for delivery were from Coptic Orthodox. While 15.58%, 11.5%, 12.49 % and 3.5 % of women who delivered their babies at health facilities were Catholics, Protestants, Muslims, and traditional believers respectively. It can be seen from the proportion of women of all religion type in table 4.1 that catholic, protestant, Muslim, and traditional believer's women were less likely to use health facilities than orthodox women.

The table revealed that the proportion of women's exposure to watching television by place of delivery care. Women who more frequently watched television tend to give birth at health facilities. Women who were more frequently watched television were more likely to use health facilities as the place for delivery compared to those who less frequently watched television. About 5.96 % of women who were not at all watching television were delivered their babies at health facilities. About 20.78 % and 64.38 % women who delivered their babies in the health facilities were exposed to watch television less than once a week and at least once a week respectively.

Rich women were more likely to use health facilities than the others. In contrast, poor women have shown less attention to the importance of using health facilities for delivery. The percentage of poor women who delivered at health facilities were 3.58 %, while the proportion of poorer, middle, richer and richest women who delivered at health facilities were 3.93 %, 4.07 %, 8.65 % and 58.11 % ,respectively.

With respect to antenatal visits, about 4.2 % women delivered their babies in health facilities without antenatal visits during pregnancy. About 16.35 % and 46.44 % women delivered their babies in health facilities after 1-3 and 4 and more visits during pregnancy. This implies that women with1-3 and 4 and more antenatal visits were more likely to deliver at health facilities than women with no antenatal visits during pregnancy.

The percentage of deliveries at health facilities among women whose husbands had no education, primary, secondary, and higher were, respectively, 5.31, 17.4, 52.86, and 63.53.

4.2 Results of cross tabulation data analysis

This topic will examine, by means of a bivariate analysis (cross tabulation) the relationships between the dimensions of maternal place of delivery care (use of choice of home delivery versus institutional delivery) and the independent variables.

Table 4.2. Summarized results of cross tabulation analysis (cross tab of each independent variable by place of delivery care)

variable	Chi-square	df	p-value
Region	1660.04	10	0.000
Mother’s age	73.11	2	0.000
Residence	2739.96	1	0.000
Mother’s edu. level	1729.15	3	0.000
Availability of TV	2364.03	1	0.000
Religion	173.19	4	0.000
Freq. of watching TV	1939.62	2	0.000
Wealth index	2547.38	4	0.000
Antenatal visits	1479.00	2	0.000
Husband’s edu. level	1432.66	3	0.000

Based on the result of the cross tabulation analysis (all p-values are less than 0.05), place of delivery care was found to be associated with mother’s Age, region, Type of place of residence, mother’s highest educational level, availability of television at home, religion, frequency of watching television, wealth index, number of antenatal visits during pregnancy, and husband/partner's education level.

4.3 Logistic regression analysis

The bivariate analysis showed that there is a significant association between selected independent variables and place of delivery care utilization in Ethiopia. However, a bivariate association between two variables does not necessarily imply a significant causal relationship between them. Therefore, it is important to carry out a statistical analysis which would incorporate more than one independent variable at a time. The most suitable analytical technique is multivariable analysis which allows the exploration of the effect of different independent variables on a dependent variable corrected for other independent variables (Tabachnick and Fidell, 2007). The multiple regression analysis method applied in this study is multiple logistic regression, which would allow the identification of the effect of selected independent variables on maternal delivery care utilization controlling for the effects of other independent variables. This chapter aims to investigate the differentials in the utilization of maternal delivery care when its relationships with the independent variable adjusted for the simultaneous effects of the different characteristics. Given the interest in the dichotomous use of modern maternal delivery care utilization, namely whether a woman utilized maternal delivery care or not, a dichotomous logistic regression was employed to determine which factors best explain and predict the outcome of the use of maternal delivery care utilization during delivery. Regarding the independent variables, by using a 25 % level of screening, only those variables which show significant relationships with place of delivery are included in the analysis. On this basis, ten independent variables used in this analysis are presented in appendix A. In order to determine the association between each independent variable and use of place of delivery, two statistics of the model are used. These are the logistic regression coefficient and the odds ratio. P-values are also presented. The logistic regression coefficients indicate the

direction of the relationship. The odds ratios (OR) represents the change in odds of being in one of the categories of outcome when the value of a predictor increases by one unit (Tabachnick and Fidell, 2007). For categorical independent variables, the test provides a separate coefficient for each category of the variable. In addition, a positive logistic regression coefficient for any category of an independent variable is associated with an odds ratio greater than one, which indicates that this category has a greater likelihood of experiencing the event relative to the reference category. Parameter estimates with negative signs indicate the opposite relationship. Odd ratio provides a meaningful way of interpreting the relationship between the independent variables and utilization of maternal delivery care. An estimated odds ratio of 1 indicates that the use of maternal delivery care utilization is no different from the relationship in the reference category. If the estimated ratio is >1, the likelihood of the use of maternal delivery care services is higher relative to the reference category. If the estimated odds ratio is <1 the probability of delivering at health facility is lower relative to the reference category.

Table 4.3. Results of maximum likelihood estimates of parameters in fitting a multiple logistic regression model

Variables /categories	$\hat{\beta}$	Estimated odds ratio (exp ($\hat{\beta}$))	Sig. value (p)	95 % CI for odds ratio
Intercept	-3.1192	0.044	0.000	
	Mother's age			
15-19	Reference category			
20-34	0.0413	1.042	0.8483	(0.683,1.591)
35-49	-0.288	0.75	0.232	(0.468,1.202)
Region				
Tigray	Reference category			
Afar	-0.137	0.872	0.6281	(0.501,1.518)
Amhara	0.679	1.972	0.001	(1.304,2.983)
Oromiya	0.299	1.342	0.160	(0.888,2.046)
Somali	0.703	2.020	0.011	(1.177,3.469)
Benishangul Gumu	0.673	1.961	0.005	(1.221,3.149)
SNNP	0.085	1.088	0.730	(0.672,1.762)
Gambela	1.249	3.487	0.000	(2.192,5.549)
Harari	1.311	3.708	0.000	(2.309,5.955)
Addis Ababa	1.326	3.765	0.000	(2.371,5.981)
Dire Dawa	2.008	7.449	0.000	(4.635,11.973)
Place of residence				
Urban	Reference category			

Rural	-1.429	0.239	0.000	(0.181,0.316)
Mother's educational level				
No education	Reference category			
Primary education	0.445	1.561	0.000	(1.252,1.945)
Secondary edu.	1.018	2.769	0.000	(1.830,4.189)
Higher	1.431	4.183	0.000	(2.256,7.756)
Household has television				
No	Reference category			
Yes	0.503	1.653	0.002	(1.209,2.260)
Religion				
Orthodox	Reference category			
Catholic	-0.005	0.995	0.991	(0.434,2.283)
Protestant	-0.186	0.830	0.289	(0.589,1.171)
Muslim	-0.558	0.572	0.000	(0.435,0.753)
Traditional	-0.323	0.724	0.673	(0.162,3.240)
Frequency of watching television				
Not at all	Reference category			
Once or not in week (irr.)	0.381	1.464	0.002	(1.152,1.859)
Two or more days a week (irr.)	0.471	1.602	0.005	(1.151,2.229)
Wealth index				
Poorest	Reference category			
Poorer	0.166	1.180	0.415	(0.793,1.756)
Middle	-0.006	0.994	0.976	(0.664,1.487)

Richer	0.362	1.436	0.044	(1.009,2.042)
Richest	0.825	2.283	0.000	(1.547,3.368)
Number of antenatal visits during pregnancy				
No antenatal visits	Reference category			
1-3	0.926	2.523	0.000	(1.974,3.224)
4+	1.431	4.182	0.000	(3.266,5.355)
Husband's educational level				
No education	Reference category			
Primary education	0.171	1.186	0.159	(0.935,1.504)
Secondary edu.	0.696	2.005	0.000	(1.437,2.798)
Higher	0.765	2.148	0.000	(1.420,3.249)

Table 4.3 presents the results of the multivariable logistic regression analysis of selected predictors affecting the use of place of delivery care in Ethiopia.

Age of woman was found to be a non significant predictor of the use of place of delivery. Even if it was not significant, women in the age group 20-34 were more likely to deliver at health facilities than women in the age group 15-19. Younger women are more likely to deliver at health facilities than older women.

Women from Afar region were 13 percent less likely to deliver at health facilities than women from Tigray region. Women in SNNP were equally likely to deliver at health facilities as women in Tigray region. Women in Amhara, Oromiya, Benishangul Gumuz and Somali were 1.97, 1.34, 1.96, 2.02 times more likely to use health facilities than women in Tigray region, respectively. While women in Gambela, Harari, Addis Ababa, and Dire Dawa were 3.49, 3.71, 3.77, 7.45 times more likely to use health facilities than women in Tigray region.

Women from rural Ethiopia were almost 76 percent less likely to deliver at health facilities than women from urban Ethiopia.

Women with primary, secondary, and higher educational level were, respectively, 1.56, 2.77, and 4.18 times more likely to deliver at health facilities.

The likelihood to deliver at health facilities for women whose husbands had primary, secondary, and higher level of education relative to those women whose husbands had no education, were 1.19, 2, and 2.15 times higher.

Women who had television were 1.65 times more likely to use health facilities for delivery than women who had not television in the household. Women who watched television irregularly once or not in a week were 1.46 times more likely to deliver their babies at health facilities than those who never watched television. Women who watched television two times or more in a week were 1.60 times more likely to deliver at health facilities than those who never watched television at all.

With the respect to religion, the findings showed that catholic was 0.5 percent less likely to deliver at health facilities than orthodox women. Women from protestant, Muslim, and traditional believers were 17, 43, and 28 percent less likely to deliver at health facilities than women who are followers of the Coptic Orthodox Church. In general religion was not a significant effect on place of delivery.

Women who belonged to the middle income (negatively associated) were 0.6 percent less likely to deliver at health facilities than women who belonged to the poorest income. Women who categorized as “poorer”, “richer”, and “richest” were 1.18, 1.436, and 2.28 times more likely to deliver in the health facilities than women who were put in the poorest rank, respectively.

Number of antenatal visits during pregnancy is an important significant predictor of place of delivery. Women who made 1 to 3 visits during pregnancy were 2.53 times more likely to deliver in the health facilities than women who were not antenatal visits during pregnancy. Similarly, women who received more than four visits during pregnancy were 4.18 times more likely to deliver in health facilities than women who had no antenatal visits during pregnancy.

4.3.1 Statistical tests and assessing model fit

Evaluation of a logistic regression model includes the overall model evaluation, statistical tests of individual predictors and goodness of fit statistics.

4.3.1.1 Statistical tests of individual predictors

The Wald test was used to test the significance of a covariate. In other words we test

$H_0: \beta_i = 0 \qquad H_A: \beta_i \neq 0, \qquad i = 1,2,\ldots..,k.$

The Wald statistic used is given by

$$W = \left[\frac{\widehat{\beta}_i}{s.d(\widehat{\beta}_i)}\right]^2$$

Under the null hypothesis W has a chi-square distribution with one degree of freedom. A small p-value indicates the significance of that predictor variable in explaining the response variable (place of delivery care). Based on the result of Wald statistic and p value given below,

Table 4.4. Results of Wald statistic with corresponding variables

Variables	DF	Wald chi-square	Pr > chi sq
Mother's age	2	6.824	0.033
Region	10	157.850	0.000
Place of residence	1	101.024	0.000
Mother's educational level	3	37.829	0.000
Household has television	1	9.920	0.002
Religion	4	16.224	0.003
Frequency of watching television	2	12.125	0.002
Wealth index	4	22.227	0.000
Number of antenatal visits during pregnancy	2	129.896	0.000
Husband's educational level	3	23.240	0.000

Each predictor variable is significant. This implies that a small p-value (p- value < 0.05) indicates significance of predictor variable in case of place of delivery care. For this test, the null hypothesis is rejected.

4.3.1.2 Statistical tests of overall model

Once again, the Primary interest here is that testing hypotheses regarding *β (global null hypothesis).*

H_o: $\beta_1 = \beta_2 = \ldots\ldots\ldots = \beta_k = 0$

Table 4.5. Results of testing Global Null hypothesis: BETA=0

Test	Chi-square	DF	Pr > chi sq
Likelihood ratio	3194.378	32	0.000
Score	3687.95	32	0.000
Wald	1574.070	32	0.000

Since p=0.0000 as shown in Table 4.5, the global null hypothesis is rejected and we conclude that at least one coefficient is different from zero.

4.3.1.3 Goodness of fit statistics

It is known that goodness of fit statistics assess the fit of the logistic model against the data. From the SAS out put the following results were obtained:

Table 4.6. Deviance and Pearson Goodness-of-Fit Statistics

Criterion	Value	DF	Value/DF	Pr > chi sq
Deviance	2857.034	5111	0.559	1.000
Pearson	5250.195	5111	1.027	0.085

This result shows the Pearson chi-square and deviance based goodness of fit statistics are insignificant. These imply a good fit of the model (the model is the good fit of the data).

The Hosmer - Lemeshow test statistic is a Pearson chi-square statistic, calculated from a 2x10 table of observed and estimated expected frequencies, where 10 is the number of groups formed from the estimated probabilities. Each group should have an equal number of observations as shown below.

Table 4.7. Partition for the Hosmer - Lemeshow Test

		PLDEL=1		PLDEL=0	
Group	Total	Observed	Expected	Observed	Expected
1	725	5	4.60	720	720.40
2	755	9	8.37	746	746.63
3	726	11	11.20	715	714.80
4	717	16	15.66	701	701.34
5	718	27	22.04	691	695.96
6	718	31	32.57	687	685.43
7	713	51	49.84	662	663.16
8	718	91	99.57	627	618.43
9	718	333	328.30	385	389.70
10	674	592	593.85	82	80.15

Hosmer - Lemeshow Goodness-of-Fit Test

Chi-square	DF	Pr > chi sq
2.383	8	0.967

In general, from the Hosmer - Lemeshow goodness of fit statistics test, the result p= 0.967 is high and is greater than the significance value p= 0.05. This result shows the model is good fit.

4.4 Validation of predicted probabilities

It is obvious that binary logistic regression predicts the logit of an event outcome by a set of predictors. The degree to which predicted probabilities match with actual outcome is expressed by a measure of association: Tau-a, Gamma, Somers's D statistic, and C statistic. Based on the following output:

Association of Predicted Probabilities and Observed Responses

Percent Concordant	92.3	Somers' D	0.849
Percent Discordant	7.4	Gamma	0.852
Percent Tied	0.3	Tau-a	0.231
Pairs	7014656	c	0.924

The Gamma statistic for the model is 0.852. It is interpreted as 85.2 % fewer errors made in predicting which of the women delivered their babies in health facilities by utilizing the estimated probabilities than women delivered their babies at home. The association between estimated probabilities and the outcomes was high. The Somers' D statistic also indicates the better the fit. For the model the c statistic is 0.924. This means that 92.4% of all pairs of women, one delivered in health facilities and the other delivered at home, the model correctly assigned a higher probability to women delivered at health facilities. That is, the model assigns higher probabilities to all observations with women delivered at health facilities, compared to women delivered their babies at home.

4.5 Model diagnostic checking

We know that the purpose of diagnostic analysis is to identify potential outliers and to understand the model's poor fit to certain observations. DFBETAs less than unity imply no specific impact of an observation on the coefficient of a particular predictor variable, Cook's distance less than unity showed that an observation had no overall impact on the estimated vector of regression coefficients β. A value of the leverage statistic less than one show that no subject has a substantial large impact on the predicted values of the model (see the Appendix D). Based on the above goodness of fit tests and diagnostic checking results, we can say that our model is adequate.

Other measures used to detect the presence of outliers and influential observations among others are the deviance residual and the Pearson residual plot. The small value of either statistic (Pearson residual or deviance residual) is indicative of highly explained covariate pattern (see the Appendix C). These statistics shows the model is adequate.

Chapter Five

Conclusions and Recommendation

5.1 Conclusions

In Ethiopia, previous studies gave information that the coverage of maternal place of delivery care utilization was not wide. While many factors contribute to maternal place of delivery care utilization, the lack of use of the utilization of delivery care at health facilities is still low.

According to the 2011 EDHS data, women in Ethiopia were more likely to have births delivered at home. The Ethiopian government has made attempts to improve maternal health care by making maternal delivery care more accessible and by improving service quality. However, the utilization of the delivery care requires large task to care both the mothers and the children. The utilization of maternal delivery care is related with accessibility, acceptability and affordability based on the socio economic and demographic characteristics of women.

With respect to the objectives of the study the major socio- demographic factors that are likely to affect maternal delivery care were mother's age, region, place of residence, mother's educational level, availability of television in the household, religion, frequency of watching television, wealth index, number of antenatal visits during pregnancy, and husband's educational level. Results suggested that all social, economical and demographic predictor variables show statistically significant relationships with place of delivery care. But the magnitude of association varies for each predictor variable. Concerning the objective that is likely to determine the magnitude of delivery in terms of place of residence, of the total, only 5 percent rural women were deliver at health facilities and 62.54 percent

urban women were deliver their babies in the health facilities. This magnitude really shows that the consequence of maternal delivery care was maternal mortality.

5.2 Recommendation

The implication is that, if an intervention towards increasing delivery at health facilities is to be targeted based on region, place of residence, mother's educational level, availability of television in the household, frequency of watching television, number of antenatal visits during pregnancy, and husband's educational level, then the government should address those regions which have less likely to deliver at health facilities and increase the levels of those maternal characteristics associated with place of delivery.

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Appendices

Appendix A: categorization of explanatory variables/maternal characteristics

Explanatory variables	Categorization/coding
Mother's age	0=15-19 1=20-34 2=35-49
Region	1= Tigray 2= Afar 3= Amhara 4= Oromiya 5= Somali 6= Benishangul Gumuz 7= SNNP 8= Gambela 9= Harari 10= Addis Ababa 11= Dire Dawa

Place of residence	1= Urban 2= Rural
Mother's educational level	0= No education 1= Primary education 2= Secondary education 3= higher
Household has television	0= No 1= Yes
Religion	1= Orthodox 2= Catholic 3= Protestant 4= Muslim 5= Traditional
Frequency of watching television	0= Not at all 1= once or not in a week 2= two or more days a week
Wealth index	1= Poorest 2= Poorer 3= Middle 4= Richer

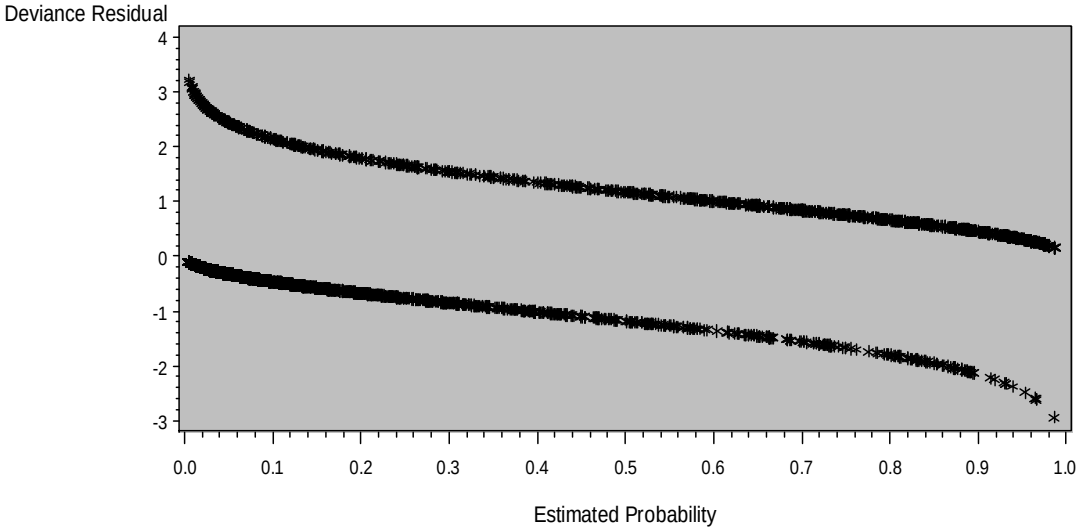
	5= Richest
Number of antenatal visits during pregnancy	0= No antenatal visits 1= 1-3 2= 4+
Husband's/partner's educational level	0= No education 1= Primary education 2= Secondary education 3= higher

Appendix B: Syntax of SAS

```
proc logistic data=sasuser.AMT descending;
class MAGE REG RESID MEDUL HASR HASTV RELI FRNP FLR FWTV
WEALTH HASCT ANTVI HEALTHI HEDUL HOCCU MOCCU/ref=first
param=ref;
model PLDEL=MAGE REG RESID MEDUL HASR HASTV RELI FRNP FLR
FWTV
WEALTH HASCT ANTVI HEALTHI HEDUL HOCCU MOCCU/tech=nr
selection=s lackfit scale=none aggregate;
output out=pred p=phat l=lower u=upper xbeta=logit
difchisq=deltachisq
difdev=deltaD H=leverage
reschi=r resdev=d;
run;
 symbol1 i=none v=star c=black;
```

```
proc gplot data=pred;
plot (deltachisq deltaD)*phat/cframe=ligr;
run;
proc gplot data=pred;
plot (r d)*phat/cframe=ligr;
run;
proc univariate data=pred plot normal;
var r d;
run;
proc freq data=sasuser.AMT;
table (MAGE REG RESID MEDUL HASR HASTV RELI FRNP FLR FWTV
WEALTH HASCT ANTVI HEALTHI HEDUL HOCCU
MOCCU)*PLDEL/chisq;
run;
```

Appendix C: Deviance residual for diagnostic checking



Appendix D: Summary of descriptive statistics for Outliers and Influential observations diagnostics

Descriptive Statistics

	N	Minimum	Maximum
Analog of Cook's influence statistics	7182	.00000	.54001
Leverage value	7182	.00032	.13482
DFBETA for constant	7182	-.15625	.54561
DFBETA for MAGE(1)	7182	-.04068	.04424
DFBETA for MAGE(2)	7182	-.01382	.01365
DFBETA for REG(1)	7182	-.02232	.03651
DFBETA for REG(2)	7182	-.03967	.05081
DFBETA for REG(3)	7182	-.02874	.03414
DFBETA for REG(4)	7182	-.02315	.03042
DFBETA for REG(5)	7182	-.03514	.03792
DFBETA for REG(6)	7182	-.03427	.03871
DFBETA for REG(7)	7182	-.03324	.04407
DFBETA for REG(8)	7182	-.03297	.03327
DFBETA for REG(9)	7182	-.02275	.02656
DFBETA for REG(10)	7182	-.02848	.03670
DFBETA for RESID(1)	7182	-.01679	.01621
DFBETA for MEDUL(1)	7182	-.05982	.08227
DFBETA for MEDUL(2)	7182	-.06055	.08091
DFBETA for MEDUL(3)	7182	-.05683	.08145
DFBETA for HASTV(1)	7182	-.02214	.01782
DFBETA for RELI(1)	7182	-.54201	.16011
DFBETA for RELI(2)	7182	-.53994	.17447
DFBETA for RELI(3)	7182	-.54120	.15906
DFBETA for RELI(4)	7182	-.54052	.16119
DFBETA for FWTV(1)	7182	-.02175	.01783
DFBETA for FWTV(2)	7182	-.01805	.01566
DFBETA for WEALTH(1)	7182	-.02047	.02584
DFBETA for WEALTH(2)	7182	-.02296	.03156
DFBETA for WEALTH(3)	7182	-.02202	.02702
DFBETA for WEALTH(4)	7182	-.02277	.01977
DFBETA for ANTVI(1)	7182	-.01327	.01109
DFBETA for ANTVI(2)	7182	-.01015	.00821

DFBETA for HEDUL(1)	7182	-.03175	.02611
DFBETA for HEDUL(2)	7182	-.03042	.02763
DFBETA for HEDUL(3)	7182	-.02794	.02600