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Addis Ababa University

School of Graduate Studies

College of Natural Sciences

Department of Statistics

FACTORS AFFECTING THE PRACTICE OF FEMALE GENITAL MUTILATION OF ETHIOPIAN WOMEN

By

Roman Assefa

A thesis submitted to the school of graduate studies of Addis Ababa University in partial fulfillment of the requirements for the degree of Master of Science in statistics

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GRADUATE STUDIES PROGRAMME

DEPARTMENT OF STATISTICS

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First of all I would like to thank the Almighty God for providing everything.

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Female genital mutilation (FGM), also known as female genital circumcision, is widely practiced throughout much of Africa mainly in relation to social, cultural and religious reasons. It is an old-age practice believed to have existed in central Africa, Egypt and the Middle East. Between 100 and 140 million girls and women worldwide are estimated to have undergone the practice of FGM.

This study attempted to identify factors that affect female genital circumcision in Ethiopia using data collected in Ethiopian demographic and health survey (EDHS, 2005). The survey collected information from a total 14070 women aged 15-49 out of which 9831 women were considered.

To address our objectives, descriptive and binary logistic regression statistical techniques were used for data analysis using socio- economic, demographic and health and environmental variables as explanatory variables and circumcision status as a response variable.

Based on the binary logistic regression analysis age of women, region, place of residence, religion, frequency of listening to radio, mother's level of education, and wealth index were found to be the most important determinants of circumcision.

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Acronym

CSA	Central Statistical Agency
MOH	Ministry of Health
EDHS	Ethiopian Demographic and Health Survey
UN	United Nation
WHO	World Health Organization
ML	Maximum Likelihood
OLS	Ordinary Least Squares
FGM	Female Genital Mutilation
FGC	Female Genital Circumcision
STIs	Sexually transmitted Infections
HIV	Human Immunodeficiency virus
FC	Female Circumcision
IAC	Inter-African Committee

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Female genital cutting (FGC), also known as female genital mutilation (FGM), female circumcision, is any procedure involving the partial or total removal of the external female genital organ whether for cultural, religious or other non – therapeutic reasons (WHO 2010). Ritual cutting and alteration of the genitalia of female infants, girls, and adolescents has been a tradition since antiquity. It persists today primarily in Africa and among small communities in the Middle East and Asia. The spectrum of these genital procedures has been termed female circumcision, or more frequently, female genital mutilation (FGM) as a collective name describing several different traditional rituals that emphasizes the physical disfigurement associated with the practice. It is estimated that at least 100 million women have undergone FGM and that between 4 and 5 million procedures are performed annually in female infants and girls, with the most severe types of FGM carried out in Somalian and Sudanese populations. Pediatricians, therefore, may encounter patients who have undergone these procedures and pediatric surgeons and pediatric urologists may be requested by patients or by the parents of patients to perform surgery considered a ritual genital operation (Kouba LJ, Muasher J (1985)).

During the past two decades several international and national humanitarian and medical organizations have drawn worldwide attention to the physical harms associated with FGM. The World Health Organization and the International Federation of Gynecology and Obstetrics have opposed FGM as a medically unnecessary practice with serious, potentially life-threatening complications (WHO, 1996). The American College of Obstetricians and Gynecologists and the College of Physicians and Surgeons of Ontario, Canada, also opposed FGM and advised their members not to perform these procedures (American College of Obstetrics and Gynecology (1995). In 1995 the Council on Scientific Affairs of the American Medical Association recommended that all physicians in the United States strongly denounce all medically unnecessary procedures to alter female genitalia, as well as promote culturally sensitive education about the physical consequences of FGM (The College of Physicians and Surgeons of Ontario (1992).

FGM is illegal and subject to criminal prosecution in several countries, including Sweden, Norway, Australia, and the United Kingdom (Jackson (1985)). In 1996 the Congress of the United States enacted legislation to criminalize the performance of FGM by practitioners on female infants and children or adolescents younger than 18 years and to develop educational programs at the community level and for physicians about the harmful consequences of the practice (Jackson (1985)).

The term female genital mutilation gained growing support in the late 1970s. The word "mutilation" not only established clear linguistic distinction from male circumcision, but it also emphasized the gravity of the act. In 1990, this term was adopted at the third conference of the Inter-African Committee on Traditional Practices Affecting the Health of Women and Children (IAC) in Addis Ababa. In 1991, the World Health Organization (WHO), a specialized agency of the United Nations (UN), recommended that the UN adopt this terminology; subsequently, it has been widely used in UN documents (WHO, 1996).

In this context, the term female circumcision was thus predominantly replaced by the term female genital mutilation. The extensive literature on the subject, the support of international organizations, and the emergence of local groups working against the continuation practices appear to suggest that an international consensus has been reached. The terminology used to refer to these surgeries has changed, and the clearly disapproving and powerfully evocative expression of "female genital mutilation" has now all but replaced the possibly inaccurate, but relatively less value laden-term of "female circumcision" (Obermeyer, 1999).

Because the term female genital mutilation has been criticized for increasing the stigma associated with female genital surgery, some groups have proposed an alteration, substituting the word "cutting" for "mutilation." According to a joint WHO/UNICEF/UNFPA statement, the use of the word "mutilation" reinforces the idea that this practice is a violation of the human rights of girls and women, and thereby helps promote national and international advocacy towards its abandonment. They state that, at the community level, however, the term can be problematic; and that local languages generally use the less judgmental "cutting" to describe the practice. They also feel that parents understandably resent the suggestion that they are "mutilating" their daughters. In this spirit, in 1999, the UN Special Rapporteur on Traditional Practices called for tact and patience regarding activities in this area and drew attention to the risk of "demonizing" certain cultures, religions, and communities. As a result, they claim, the term "cutting" has increasingly come to be used to avoid alienating communities (Lewnes, 2005).

In 1996, the Uganda-based initiative REACH (Reproductive, Educative, and Community Health) began using the term female genital cutting, observing that female genital mutilation may "imply excessive judgment by outsiders as well as insensitivity toward individuals who have undergone some form of genital excision" (United Nations, 1996). While some international organizations, such as the UN and the WHO, continue to use the earlier term of female genital mutilation, a number of agencies, like UNICEF, now use the term female genital mutilation/cutting (FGM/C).

Approximately 95% of circumcisions are performed on children younger than 17 years old, with some as young as a day old. In some countries, large groups of girls are circumcised at once, while in other countries, the ritual is treated as a more personal, family matter, and each girl is circumcised individually. Women perform the circumcisions in most areas, but male barbers carry out the task in Egypt. To begin, a girl is stripped naked and either laid down or seated. During the procedure, she is restrained by other women, usually female relatives, and her legs may be tied together to reduce movement and promote healing. In urban areas of Africa, midwives sometimes use local anesthetic, but FGM is often an extremely crude operation performed without any form of analgesic. There are even cases in which the implement used is a piece of glass or a sharp stone (Wright, 1996).

FGC is performed on infants, girls, and women of all ages. The age at which girls are cut can vary widely from country to country, and even within countries.

The practice of FGC is a cultural tradition performed across central Africa, in the southern Sahara, and in parts of the Middle East. Most women who have experienced FGC live in one of the 28 countries in Africa and the Middle East where FGC is practiced. Almost one-half of women who have experienced FGC live in Egypt or Ethiopia. In Egypt, (2008) Demographic and Health Survey (DHS) information notes that female genital cutting rates are declining.

To a lesser degree, FGC is practiced in Indonesia, Malaysia, Pakistan, and India. Some immigrants practice various forms of FGC in other parts of the world, including Australia, Canada, New Zealand, the United States, and in European nations (http://www.prb.org).

There are many reasons FGC is practiced, including social, economic, and political reasons. Those who support FGC believe that it will empower their daughters, ensure the girls get married, and protect the family's good name. In some groups, FGC is performed to show a girl's growth into womanhood and, as in the Masai community, marks the start of a girl's sexual debut. It also is performed to keep a woman's virginity by limiting her sexual behavior. FGC is believed (by those who practice it) to reduce a woman's sexual desire. In some groups, women who are not cut are viewed as dirty and are treated badly. While FGC pre-dates both Christianity and Islam, religion is also used to promote the practice. Some communities believe that in order to be good Muslims, parents must have their daughters cut.

There are also many superstitions about FGC such as: The clitoris will continue to grow as a girl gets older and so it must be removed, and that the external genitalia are unclean and can actually cause the death of an infant during delivery.

1.2 Statement of problem

According to Shell-Duncan, B. (2001), female genital mutilation is a widespread cultural practice and affects millions of young women.

FGC can cause a range of health problems, both short-term and long-term. The kinds of problems that develop depend upon the degree of the cutting, the cleanliness of the tools used to do the cutting, and the health of the girl or woman receiving the cutting. In most countries, FGC is performed in unclean conditions by mainly traditional practitioners who may use scissors, razor blades, or knives.

Short-term health problems like Bleeding, Infection, Pain, and Trauma.

Long-term health problems like Problems going to the bathroom, Problems with gynecological health, Increased risk of sexually transmitted infections

(STIs)including HIV, Psychological and emotional stress, Problems getting pregnant and problems during pregnancy and labor.

1.3 Objective of the study

The main objectives of this study are to identify various factors that influence female genital Circumcision in Ethiopia and to know FGC rate.

The Specific objectives of the study are

-To identify factors that have impact on FGC practice.

-To investigate regional differences in FGC.

-To determine the prevalence of FGC.

1.4 Significance of the study

Among practicing cultures, FGC is most commonly performed between the ages of four and eight, but can take place at any age from infancy to adolescence. Prohibition has led to FGC going underground, at times with people who have had no medical training performing the cutting without sterilization or the use of proper medical instruments. The procedure can lead to death through shock from excessive bleeding. The failure to use sterile medical instruments may lead to infections.

Other serious long term health effects are also common. These include urinary and reproductive tract infections, caused by obstructed flow of urine and menstrual blood, various forms of scarring and infertility. Epidermal inclusion cysts may form and expand, particularly in procedures affecting the clitoris. These cysts can grow over time and can become infected, requiring medical attention such as drainage. Moreover FGC would expose women to greater risk of HIV. Clearly, stopping FGC will reduce the above health problems.

The study is an attempt to reveal the major responsible factors and their negative contribution to female genital mutilation and health problem of women so that governmental and non – governmental organizations could take intervention measures and set appropriate plans to tackle the existing female genital circumcision by identifying and giving priority to the areas where this kind of practice is performed.

1.5 Limitations of the study

- ✓ Data problem
  - Some important variables are not included because of missing values and non-responses.

- ✓ The data, used in this study are from the EDHS 2004/05. Thus, the results may not necessarily reflect the current situation of Ethiopia.

CHAPTER TWO

LITERATURE REVIEW

2.1 Concepts, definitions and determinants of female genital Circumcsion

Female genital mutilation (FGM), often euphemistically referred to as female circumcision, is a widespread practice. Estimates of its incidence vary widely, but they tend to agree that there are over 100 million women in the world who have been circumcised, with 2 million more at risk every year (Bosch, 2001). It is concentrated in northern Africa, but it also occurs to a lesser extent in the Middle East, Ethiopia especially in Somali society, the practice of FGM is an honored tradition, southern Asia, among indigenous groups in South America, and even in some African immigrant populations in Europe, Australia, and North America. Numerous international health and human rights organizations have condemned the procedure for the extensive biological and psychological trauma it can impose on girls and women for their entire lives.

Female genital cutting (FGC) is a common practice in many societies located north of the equator in sub-Saharan Africa. Nearly universal in a small number of countries, it is practiced by various ethnic groups in at least 25 African countries. In some societies, the procedure is routinely carried out when a girl is a few weeks or a few months old, while in others, it occurs later in childhood. In the case of the latter, FGC is typically part of a ritual initiation into womanhood that includes a period of seclusion and education about the rights and duties of a wife. It is often assumed that FGC "is an 'ancient' and deeply entrenched practice, that it is associated with initiation, with Islam, and with patriarchy" (Shell-Duncan and Hernlund, 2000).

Jackson et al (2003) report on a longitudinal study of women aged 15 to 49 in rural northern Ghana. The self-reported circumcision status of women interviewed in 1995 was compared with the status they reported when they were interviewed again in 2000 after the government began enforcing a law banning the practice and public information campaigns against it were launched. In all, 13 percent of respondents who reported in 1995 that they had been circumcised denied that they were circumcised in the 2000 re-interview, although denial rates were as high as 50 percent in the youngest age group. Jackson et al show that women who denied being circumcised are significantly younger, more likely to be educated, and less likely to practice traditional religion than are women who reported that they were circumcised. Factors that may explain these correlates of denial are discussed, and implications for research are reviewed. Female genital cutting, also known as female circumcision or female genital mutilation, has received growing attention from governmental and international organizations during the past decade. It is commonly considered a human rights violation, and international pressure has been exerted on governments, communities, and individuals to eliminate the practice (Shell-Duncan and Hernlund 2000). At the same time that a variety of strategies to discourage the practice have been implemented, researchers have called for increased rigor in documenting the specific health effects of genital cutting and the impact of intervention programs to end it (Obermeyer 1999). Interest in research to document the prevalence, determinants, and health effects of genital cutting, as well as in development of appropriate intervention strategies with proved effectiveness, is growing rapidly (Sedgh and Jackson 2003).

Accurate measurement of the circumcision status of individuals is crucial to the success of the research agenda. Accurate assessment of individual's status is necessary for evaluation of interventions, for studies of the determinants of the practice, and for investigations of prevalence trends given in national surveys. By 2001, the Demographic and Health Surveys had collected data in 12 countries in Africa. Investigation of the possibility of response bias assumes growing importance as the legislation and informational campaigns against the practice increase, possibly affecting survey-response validity. Jackson et al (2003) examined the determinants of inconsistent self-reporting of circumcision status by comparing women's self-reported status from survey responses in 1995 with repeat-interview responses in 2000 for a sample population living in a rural area of northern Ghana, where the practice of female genital cutting has been the subject of legislation and informational campaigns.

Okonofu et al (2002) examined the association between female genital cutting and frequency of sexual and gynecological symptoms among a cohort of cut versus uncut women in Edo State of Nigeria. The design used is cross sectional study. The sample for the study included 1836 women. Information about type of female genital cutting was based on medical exams while a structured questionnaire was used to elicit information on the women's socio demographic characteristics, their ages of first menstruation (menarche), first intercourse, marriage and pregnancy, sexual history and experiences of symptoms of reproductive tract infections. Associations between female genital cutting and these correlates of sexual and gynecologic morbidity were analyzed using univariate and multivariate logistic regression and Cox models. Frequency of self-reported orgasm achieved during sexual intercourse and symptoms of reproductive tract infections were summarized as follows.

Forty-five percent were circumcised and 71% had type 1, while 24% had type 2 female genital cutting. No significant differences between cut and uncut women were observed in the frequency of reports of sexual intercourse in the preceding week or month, the frequency of reports of early arousal during intercourse and the proportions reporting experience of orgasm during intercourse. There was also no difference between cut and uncut women in their reported ages of menarche, first intercourse or first marriage in the multivariate models controlling for the effects of socio-economic factors. In contrast, cut women were 1.25 times more likely to get pregnant at a given age than uncut women. Uncut women were significantly more likely to report that the clitoris is the most sexually sensitive part of their body (OR = 0.35, 95% CI = 0.26-0.47), while cut women were more likely to report that their breasts are their most sexually sensitive body parts (OR = 1.91; 95% CI = 1.51-2.42). Cut women were significantly more likely than uncut women to report having lower abdominal pain (OR = 1.54, 95% CI = 1.11-2.14), yellow bad-smelling vaginal discharge (OR = 2.81, 95% CI = 1.54-5.09), white vaginal discharge (OR = 1.65, 95% CI = 1.09-2.49) and genital ulcers (OR = 4.38, 95% CI 1.13-17.00). Female genital cutting in this group of women did not attenuate sexual feelings. However, female genital cutting may predispose women to adverse sexuality outcomes including early pregnancy and reproductive tract infections. Therefore, female genital cutting cannot be justified by arguments that suggest that it reduces sexual activity in women and prevents adverse outcomes of sexuality according to the findings of Okonofu et al (2002).

Rahlenbeck and Mekonnen (2009) reported that in 2005, the prevalence of FGC in women of reproductive age in the Amhara region of Ethiopia was 69%, while 64% of mothers with daughters had a circumcised daughter. Nearly four out of five (77%) women with ages between 45 and 49 years were afflicted and about the same rate (79%) in this age group had daughters on whom she had let the procedure be performed. Their finding suggests that the practice was still widely approved of thirty years ago, as women in this age group began to have their first daughters. In fact, efforts to eliminate FGC in Ethiopia started no longer than 25–30 Years ago. Prevalence of FGC in daughters decreased since then with decreasing maternal age: while in 2000, three quarters of mother's age 30–39 years reported having a circumcised daughter; only 64% did so in 2005. Similar observations are made in younger birth cohorts and do reflect a declining prevalence over time.

According to Elgaali et al (2005), female circumcision (FC) has remained a common practice in the countries where it has traditionally been performed. Following increased global mobility, it has also become a common medical issue in the predominantly non-Islamic countries where an increasing number of immigrants from regions where FC is still traditional, have settled. To investigate types of FC found in a group of immigrants from northern Africa with a current domicile in Scandinavia; to characterize these women with regard to education, socio-economic status and experienced complications and sequelae; to report attitudes to FC among the women and their husbands; an autoquestionnaire was distributed to 220 immigrant women (16-42 years old), who belonged to an African community in Scandinavia and who had all been circumcised. Information was also gathered concerning 76 of their daughters (aged 1-13 years). Of the women's husbands, 95 were asked about their attitudes to FC. Of the 140 women, who had been circumcised in their home country before they migrated, 78 (35%) had been clitoridectomized, 38 (17%) had been subjected to genital excision and 24 (11%) to infibulations. The corresponding percentages in the remaining women, who had FC when returning home for a visit, were 0%, 14% and 22%, respectively. Of the daughters, 15 (19%) had been circumcised whilst living in Scandinavia; all had been clitoridectomized. Twenty-eight (13%) women reported having experienced late complications or post-FC sequelae. A positive attitude to stopping the tradition of FC was reported twice as often by the husbands (69%) as by the circumcised women (35%). Religion (95% of the responders were Muslims and 5% Christians), cultural tradition, and increased chance of marriage or of continued health were the reasons put forward in favor of the continuation of FC by 58%, 27%, 10% and 4 %, respectively. Five percent could not supply an opinion.

FC is performed in immigrant women even after settling in areas where this practice is legally banned. Circumcised immigrant women experience medical and sexual problems which have to be dealt with in their new domicile country. Many

African Islamic women, who have migrated to Scandinavia, seem still to be in favor of the continuation of circumcision for varying reasons.

Koso-Thomas (1987) interviewed 400 women in Sierra Leone, 369 of who had been circumcised, and asked why they thought women submit to circumcision. Of these, 257 answered tradition, 105 claimed societal acceptance, 51 said religion, and with 12 or fewer respondents each: increasing chances to marry, preservation of virginity, female hygiene, prevention of promiscuity, enhancement of fertility, to please husband, and to maintain health. It has already been mentioned that female circumcision clearly doesn't improve female hygiene, enhance fertility, or maintain health, but it turns out that most of the rest of the rationales listed here are the result of misconceptions as well.

A study by Gage and Van Rossem (2005) investigated socioeconomic correlates of and gender differences in attitudinal support for the discontinuation of FGC in Guinea. Data from structured interviews of men aged 15–59 and women aged 15–49 years in the 1999 Demographic and Health Survey and multiple logistic regression methods were used to examine the relationship of socioeconomic factors and gender to attitudinal support for the discontinuation of FGC. More than 9 out of 10 women had undergone FGC. Attitudinal support for FGC discontinuation was more prevalent among men than women. The odds of supporting the discontinuation of FGC were negatively related to beliefs in social approval of and religious support for FGC and its enhancement of women's marriage ability, the number of perceived advantages of FGC, and women's low socioeconomic status. Community education, improvements in women's socioeconomic status and traditional and religious leader involvement would be critical for FGC eradication.

According to Getnet Mitike and Wakgari Deressa (2009**),** Eastern Ethiopia hosts a substantial number of refugees who originated from Somalia where Female genital mutilation (FGM) is a common practice in the area, despite the campaigns to eliminate it. They conducted a cross-sectional study among 492 respondents sampled from three refugee camps in Somali Regional State, Eastern Ethiopia, to determine the prevalence and associated factors of FGM. Data were collected using pre-tested structured questionnaires. They also used logistic regression for analyzing the practice of FGM and intention to circumcise after controlling for age of daughters, sex, educational status and other socio-economic factors. The study revealed that FGM was significantly associated with age of the parent and their involvement in anti-FGM interventions; FGM was more reported among younger parents <35 years (adjusted OR = 6.7, 95% CI 2.6–16.7), while less practice was reported among parents who participated at least in one of the anti-FGM activities (adjusted OR = 0.3, 95% CI 0.2–0.6); No statistically significant association was found between the practice of FGM and the duration of residence in the refuge camp, educational status of the parent or knowledge of the major complications related to the practice; Intention to circumcise a daughter was significantly associated with sex of the respondents and their participation in anti-FGM interventions; Being male (adjusted OR = 0.28, 95% CI 0.15–0.55) and being involved in anti-FGM interventions (adjusted OR = 0.56, 95% CI 0.42–0.98) were associated with low intention to practice FGM. They concluded that FGM is widely practiced among the Somali refugee community in Eastern Ethiopia, and there was a considerable support for the continuation of the practice particularly among women. The findings indicate a reported shift of FGM from its severe form to milder clitoral cutting. More men than women positively viewed anti-FGM interventions, and fewer men than women had the intention to let their daughters undergo FGM, indicating the need to involve men in anti-FGM activities.

2.2 Prevalence

The World Health Organization estimates that between 100 and 140 million women worldwide have been affected by some form of FGC, with the potential of 3 million procedures being performed every year (WHO, 2010). Female genital cutting is today mainly practiced in African countries. It is common in a band that stretches from Senegal in West Africa to Somalia on the East coast, as well as from Egypt in the north to Tanzania in the south. It is also practiced by some groups in the Arabian Peninsula. The country where FGC is most prevalent is Somalia, followed by Egypt, Sudan, Ethiopia, and Mali. Among ethnic Somali women, infibulations is traditional and nearly universal. Recent figures estimate that 90 percent of Egyptian women have undergone FGC. Egypt recently passed a law banning FGC ("Egypt forbids female circumcision BBC News, 2007-06-28).

Whilst FGC is widely practiced out in the open by Africans of all faiths, it is practiced in secrecy in some parts of the Middle East. In the Arabian Peninsula, Sunna circumcision is usually performed; especially among Arabs (ethnic groups of African descent are more likely to prefer infibulations). The practice occurs particularly in northern Saudi Arabia, southern Jordan, and Iraq (Gynécologie sans Frontières.27.03.2006). In the Iraqi village of Hasira, a recent study found that 60 percent of the women and girls reported having had the procedure.

CHAPTER THREE

DATA AND METHODOLGY

3.1 Data

The data used in this study were obtained from the 2005 Ethiopian Demographic and Health Survey (EDHS). This survey was the second national demographic and health survey conducted by the Central Statistical Agency (CSA). The 2005 EDHS were collected with the prime objective of generating health and demographic information on female circumcision, family planning, fertility level and determinants, infant, child, adult and maternal mortality, child and maternal nutrition, malaria, women's empowerment, and knowledge of HIV/AIDS along with other household characteristics in the nine regions and two administrative regions both in rural and urban areas. The study used data from the 2005 EDHS with reference to a total of 14,070 women in the age group 15-49 years.

3.2 VARIABLES IN THE STUDY

The dependent variable, Circumcisions status is a dichotomous random variable with "Circumcised" (coded as 1) and "not circumcised" (coded as 0). Factors that influence female circumcision included in the study are: place of residence (urban, rural), religion, mother level of education, region, partners occupation, frequency of listening to radio, mother age and wealth index.

3.3 Description and coding of response and predictor variables

Table 3.1 The Response variable

variable	Representation of variable	categories
Circumcision status	Y	1= circumcised
		0=not circumcised

Table 3.2 Predictor variables

variable	Representation of variable	categories
1. place of residence	X_1	1=urban 2=rural
2. religion	X_2	1=Coptic orthodox 2=catholic 3=protestant 4=Muslim 5=traditional 6=others
3. partners occupation	X_4	0=did not work 1=professional Technical manager 2=clerical 3=sales 4=Agric-self employed 5=services 6=skilled manual

		7=unskilled manual
4. frequency of listening to radio	X_5	0=not at all 1=less than once a week 2=at least once a week 3=almost every day
5.mothers' level of education	X_6	0=no education 1=primary 2=secondary 3=higher
6. region	X_8	1=Tigray 2=Afar 3=Amhara 4=Oromiya 5=Somali 6=Ben-Gumuz 7=SNNP 8=Gambela 9=Hareri 10=Addis Ababa 11=Dire Dawa
7.wealth index	X_9	1=poor 2=middle 3=rich
8.mother's Age	X_{10}	1=15-19 2=20-24 3=25-29

		4=30-34 5=35-39 6=40-44 7=45-49

3.4 METHODOLOGY

3.4.1 The Logistic Regression

Logistic regression is part of a category of statistical models called generalized linear models. This broad class of models includes ordinary regression and ANOVA, as well as multivariate statistics such as ANCOVA and log linear regression. An excellent treatment of generalized linear models is presented in Agresti (1996).

Logistic regression allows one to predict a discrete outcome, such as group membership, from a set of variables that may be continuous, discrete, dichotomous, or a mix of any of these. Generally, the dependent or response variable is dichotomous, such as presence/absence or success/failure. Discriminant analysis is also used to predict group membership with only two groups. However, discriminant analysis can only be used with continuous independent variables. Thus, in instances where the independent variables are categorical, or a mix of continuous and categorical, logistic regression is preferred (Agresti ,1996).

3.4.1.1 The Model

The dependent variable in logistic regression is usually dichotomous, that is, the dependent variable can take the value 1 with a probability of success θ, or the value 0 with probability of failure $1-\theta$. This type of variable is called a Bernoulli (or binary) variable. Although not as common and not discussed in this treatment, applications of logistic regression have also been extended to cases where the dependent variable is of more than two cases, known as multinomial or polytomous .Tabachnick and Fidell (1996) use the term polychotomous logistic regression.

Logistic regression makes no assumption about the distribution of the independent variables. The relationship between the predictor and response variables is not a linear function in logistic regression; instead, the logistic regression function is used, which is the logit transformation of θ:

$$\theta = \frac{e^{(\alpha+\beta_1 x_1+\beta_2 x_2+\ldots+\beta_k x_k)}}{1+e^{(\alpha+\beta_1 x_1+\beta_2 x_2+\ldots+\beta_k x_k)}}$$

Where α is the constant of the logit equation and $\beta_1, \beta_2, \ldots, \beta_k$ are the coefficients of the predictor variables.
An alternative form of the logistic regression equation is:

$$\text{logit}[\theta(x)] = \log\left[\frac{\theta(x)}{1-\theta(x)}\right] = \alpha + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_k x_k$$

Or

$Z = \alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k x_k$, where Z= logit [θ(x)]

Here α is called the "intercept" and β_1, β_2, β_3, and so on, are called the "regression coefficients" of X_1, X_2, X_3 and so on respectively. The intercept is the value of Z when the value of all independent variables is zero. Each of the regression coefficients describes the size of the contribution of that risk factor. A positive regression coefficient means that the explanatory variable increases the probability of the outcome, while a negative regression coefficient means that the variable decreases the probability of that outcome; a large regression coefficient means that the risk factor strongly influences the probability of that outcome; while a near-zero regression coefficient means that risk factor has little influence on the probability of that outcome.

3.4.1.2 Odds ratio

The odds of some event happening (e.g. the event that $Y = 1$) is defined as the ratio of the probability that the event will occur to the probability that the event will not occur. That is, the odds of an event E is given by

$$odds(E) = \frac{p(E)}{p(notE)} = \frac{p(E)}{1 - p(E)}$$

The odds ratio, which is Exp(β), is the factor by which odds(event) changes for a 1 unit change in X. The odds ratio is a measure of effect size, describing the strength of association or non-independence between two binary data values. It is used as a descriptive statistic, and plays an important role in logistic regression. Unlike other measures of association for paired binary data such as the relative risk, the odds ratio treats the two variables being compared symmetrically, and can be estimated using some types of non-random samples.

The estimated odds is simply the ratio of the estimated proportions for the two possible outcomes. If $\hat{p}$ is the proportion for one outcome, then $1 - \hat{p}$ is the proportion for the second outcome:

$$ODDS = \frac{\hat{P}}{1 - \hat{P}}$$

This is the ratio of the probability of occurrence of an event to the probability of non-occurrence of the event.

There are two main uses of logistic regression. The first is the prediction of group membership. Since logistic regression calculates the probability of success over the probability of failure, the results of the analysis are in the form of odds ratio. Logistic regression also provides knowledge of the relationships and strengths among the variables.

3.4.1.3 Assumptions of logistic regression

Logistic regression does not make many of the key assumptions of linear regression and general linear models that are based on ordinary least squares algorithms – particularly regarding linearity, normality, homoscedasticity, and measurement level.

Firstly, it does not need a linear relationship between the dependent and independent variables. Logistic regression can handle all sorts of relationships, because it applies a non-linear log transformation to the predicted odds ratio. Secondly, homoscedasticity is not needed. Logistic regression does not require error variance to be homoscedastic. Lastly, logistic regression can handle ordinal and nominal data as independent variables. The independent variables do not need to be metric (interval or ratio scaled).

However some other assumptions still apply:-

Logistic regression requires the dependent variable to be categorical. Reducing an ordinal or even metric variable to dichotomous level loses a lot of information, which makes the logistic regression inferior compared to ordinal regression in these cases.

Secondly, since logistic regression assumes that P(Y=1) is the probability of the event occurring, it is necessary that the dependent variable is coded accordingly.

That is, for the factor level 1, the dependent variable should represent the desired outcome.

Thirdly, the logistic regression model should be fitted correctly. Neither over -fitting nor under-fitting should occur. That is only the meaningful variables should be included, but also all meaningful variables should be included.

Fourthly, the error terms need to be independent. Logistic regression requires each observation to be independent. That is that the data-points should not be from any dependent samples design, e.g., before-after measurements, or matched pairings. Also the model should have little or no multicollinearity in a situation where the predictor variables are continuous. That is that the independent variables should be independent from each other. However, there is the option to include interaction effects of categorical variables in the analysis and the model. If multicollinearity is present centering the variables might fix, i.e. deducting the mean of each variable. If this does not lower the multicollinearity a factor analysis with orthogonally rotated factors should be done before the logistic regression is estimated.

Fifthly, logistic regression assumes linearity of independent variables and log odds. Whilst logistic regression does not require the dependent and independent variables to be related linearly, it requires that the independent variables are linearly related to the log odds. Otherwise the logistic regression underestimates the strength of the relationship and rejects the relationship to easily, that is being not significant (not rejecting the null hypothesis) where it should be significant. A solution to this problem is the categorization of the independent variables. That is transforming metric variables to ordinal level and then including them in the logistic regression model.

Lastly, logistic regression requires quite large sample sizes. Because maximum likelihood estimates are less powerful than ordinary least squares (e.g., simple linear regression, multiple linear regression); whilst OLS needs 5 cases per independent variable in the analysis, ML needs at least 10 cases per independent variable, some statisticians recommend at least 30 cases for each parameter to be estimated.

3.4.1.4 Parameter estimation

Maximum likelihood estimation (MLE) is the method used to calculate the logit coefficients. This contrasts to the use of ordinary least squares (OLS) estimation of coefficients in regression. OLS seeks to minimize the sum of squared distances of the data points to the regression line. ML methods seek to maximize the log likelihood (LL) which reflects how likely it is (the odds) that the observed values of the dependent variable may be predicted from the observed values of the independents variables.

In logistic regression, the likelihood equations are non-linear explicit function of unknown parameters. Therefore, we use a very effective and well known Newton-Raphson iterative method to solve the equations which is known as iteratively reweighted least squares algorithm.

In general, the sample likelihood function is defined as the joint probability function of the random variables. Specifically, suppose (y_1, $y_2 \ldots y_n$) are the n independent random observations corresponding to the random variables (Y_1, $Y_2, \ldots, Y_n$). Since the Yi is a Bernoulli random variable, the probability function of Y_i is $f_i(y_i) = \pi_i^{y_i} (1-\pi_i)^{1-y_i}$; Yi = 0 or 1; i = 1, 2, ..., n, since Y's are assumed to be independent, the joint probability function or likelihood function is given by:

$$g(Y_1, Y_2, \ldots, Y_n) = \prod_{i=1}^{n} \pi_i^{Y_i} (1-\pi_i)^{1-Y_i}$$

the log-likelihood function as:

$$L(\beta_o, \beta_1, ...\beta_p) = -\sum_{i=1}^{n} Y_i(\beta_o + \beta_1\chi_1 + ... + \beta_p\chi_p) - \sum_{i=1}^{n} \ln\{1 + \exp(\beta_o + \beta_1\chi_1 + ... + \beta_p\chi_p)\}$$

The most effective and well known Newton-Raphson iterative method can solve the equations.

3.4.1.5 Overall Model Fit

a. Deviance

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.

D = - 2Σ {LL (saturated) – LL (model)}

R^2 for Logistic Regression

In logistic regression, there is no true R^2 value as there is in OLS regression. However, because deviance can be thought of as a measure of how poorly the model fits (i.e., lack of fit between observed and predicted values), an analogy can be made to sum of squares residual in ordinary least squares. The proportion of unaccounted for variance that is reduced by adding variables to the model is the same as the proportion of variance accounted for, or R^2.

$$R^2\text{logistic} = \frac{-2LLnull - 2LLk}{-2LLnull}$$

Where the null model is the logistic model with just the constant and the k model contains all the predictors in the model. (Hosmer, D.W., & Lemeshow, S. 2000).

In SPSS, there are two modified versions of this basic idea, one developed by Cox & Snell and the other developed by Nagelkerke. The Cox and Snell R-square is computed as follows:

$$\text{Cox \& Snell Pseudo-}R^2 = 1 - \left[\frac{-2LLnull}{-2LLk}\right]^{\frac{2}{n}}$$

Because this R-squared value cannot reach 1.0, Nagelkerke modified it. The correction increases the Cox and Snell version to make 1.0 a possible value for R-squared. (Hosmer, D.W., & Lemeshow, S. 2000).

$$\text{Nagelkerke Pseudo-}R^2 = \frac{1-\left[\frac{-2LLnull}{-2LLk}\right]^{2/n}}{1-\left[-2LLnull\right]^{2/n}}$$

b. Likelihood-Ratio Test

The likelihood-ratio test uses the ratio of the maximized value of the likelihood function for the full model (L_1) over the maximized value of the likelihood function for the simpler model (L_0). The likelihood-ratio test statistic equals

$$-2\log\left(\frac{L_0}{L_1}\right) = -2[\log(L_0) - \log(L_1)] = -2(L_0 - L_1)$$

This log transformation of the likelihood function yields a chi-squared statistic. This is the recommended test statistic to use when building a model through backward stepwise elimination. (Long, J.S. 1997)

c. Hosmer-Lemshow Goodness of Fit Test

The Hosmer-Lemshow statistic evaluates the goodness-of-fit by creating 10 ordered groups of subjects and then compares the number actually in each group (observed) to the number predicted by the logistic regression model (predicted). Thus, the test statistic is a chi-square statistic with a desirable outcome of non-significance indicating that the model prediction does not significantly differ from the observed. Using grouping strategy, the Hosmer – Lemeshow goodness-of- fit statistic, $\hat{C}$ is obtained by calculating the Pearson chi-square statistic from the g×2 table of observed and estimated expected frequencies. A formula defining the calculation of $\hat{C}$ is as follows

$$\hat{C} = \sum_{k=1}^{g} \frac{\left(o_k - n'_k \overline{\pi}_k\right)^2}{n'_k \overline{\pi}_k \left(1 - \overline{\pi}_k\right)}$$

where, g denotes the number of groups, n'_k is the number of observations in the k^{th} group, o_k is the sum of the Y values for the k^{th} group and $\overline{\pi}_k$ is the average of the ordered $\overline{\pi}_k$ for the k^{th} group. Hosmer and Lemeshow (1980) demonstrated that under the null hypothesis that the fitted logistic regression model is the correct model, the distribution of the statistic $\hat{C}$ is well approximated by the chi-square distribution with g-2 degrees of freedom. This test is more reliable and robust than the traditional chi-square test (Agresti, 2002).

3.4.1.6 Checking model adequacy

Logistic regression is a sophisticated statistical tool for data analysis in both controlled experimentation and observational studies. The goal of logistic regression is to correctly predict the category of outcome for individual cases using the most parsimonious model. To accomplish this goal, a model is created that includes all predictor variables that are useful in predicting the response variable. The logistic regression model is being used with increasing rate in various fields in data analysis. In spite of such increase, there has been no commensurate increase in the use of commonly available methods for assessing the model adequacy. Failure to address model adequacy may lead to misleading or incorrect inferences. Therefore, the goal of this study is to present an overview of a few easily employed methods for assessing the fit of logistic regression models. (Jennings, D.E., 1986)

3.4.1.7 Significance of coefficients

Wald Test

A Wald test is used to test the statistical significance of each coefficient (β) in the model. The statistic is defined as

$$Z^2 = \left(\frac{\breve{\beta}_i}{S.E\left(\breve{\beta}_i\right)} \right)^2$$

The square of Z, Z^2, yields the Wald statistic with a chi-square distribution. However, several authors have identified problems with the use of the Wald statistic. Menard (1995) warns that for large coefficients, standard error is inflated, lowering the Wald statistic (chi-square) value. Agresti (1996) states that the likelihood-ratio test is more reliable for small sample sizes than the Wald test.

Score test

As with the Wald test, the Lagrange multiplier test requires estimating only a single model. The difference is that with the Lagrange multiplier test, the model estimated does not include the parameter(s) of interest. The test statistic is calculated based on the slope of the likelihood function at the observed values of the variables in the model (predictor variables). This estimated slope or "score" is the reason the Lagrange multiplier test is sometimes called the score test. The scores are then used to estimate the improvement in model fit if additional variables were included in the model. The test statistic is the expected change in the chi-squared statistic for the model if a variable or set of variables is added to the model. Because it tests for improvement of model fit if variables that are currently omitted are added to the model, the Lagrange multiplier test is sometimes also referred to as a test for omitted variables. Agresti (1996)

3.4.1.8 Regression Diagnostics

Regression diagnostics were developed to measure various ways in which a regression relation might derive largely from one or two observations.

Residuals Analysis

Residual analysis for logistic regression is more difficult than the linear regression models because the responses take on only the values 0 and 1. Thus the i^{th} ordinary residual will assume one of the two values as

$$\hat{\varepsilon}_i = \begin{cases} 1 - \hat{\pi}_i, Y_i = 1 \\ -\hat{\pi}_i, Y_i = 0 \end{cases}$$

The ordinary residuals will not be normally distributed and, indeed their distribution under the assumption that the fitted model is correct is unknown. Plots of ordinary residuals against fitted values will generally be uninformative. In linear regression a key assumption is that the error variance does not depend on the conditional mean E (Y|X). However, in logistic regression, there are binomial errors and, as a result, the error variance is a function of the conditional mean as V (Y|X) = $\pi(1-\pi)$. Hence, the ordinary residual can be made more comparable by dividing them by the estimated standard error of Y_i which is known as Pearson residual denoted by pr_i and defined as

$$pr_i = \frac{\hat{\varepsilon}}{\sqrt{\hat{\pi}_i\left(1-\hat{\pi}_i\right)}} = \frac{Y_i - \hat{\pi}_i}{\sqrt{\hat{\pi}_i\left(1-\hat{\pi}_i\right)}}$$

The Pearson residuals are directly related to the Pearson chi-square goodness-of-fit statistic. The square of Pearson residual measures the contribution of each binary response to the Pearson chi-square test statistic but the test statistic does not follow an approximate chi-square distribution for binary data without replicates. The Pearson residuals do not have unit variance since no allowance has been made for the inherent variation in the fitted value. A better procedure is to further standardize the ordinary residuals by their estimated standard deviation that is called studentized Pearson residuals. Then studentized Pearson residuals spr_i are defined as

$$spr_i = \frac{Y_i - \hat{\pi}_i}{\sqrt{\hat{\pi}_i\left(1-\hat{\pi}_i\right)\left(1-h_{ii}\right)}} = \frac{pr_i}{\sqrt{1-h_{ii}}}$$

Where h_{ii} is the i^{th} diagonal element of the $n \times n$ estimated hat matrix H.

Studentized Pearson residuals are primarily helpful in identifying influential observations and those build in information about the influence of a case, whereas Pearson residuals do not. More influential cases with high leverages result in high studentized Pearson residuals. Studentized Pearson residuals approximately follow the standard normal distribution for large ($n \geq 30$) sample and it can be used as an approximate chi-square distribution.

Deviance residual is another type of residual. It measures the disagreement between any component of the log likelihood of the fitted model and the corresponding component of the log likelihood that would result if each point were fitted exactly. Since, the logistic regression uses the maximum likelihood principle; the goal in logistic regression is to minimize the sum of the deviance residuals. Deviance residuals can also be useful for identifying potential outliers or misspecified cases in the model. The deviance residual for the i^th^ case is defined as the signed square root of the contribution of that case to the sum for the model deviance as:

$$dr_i = sign\left(Y_i - \hat{\pi}_i\right)\left\{-2\left[Y_i \ln\left(\hat{\pi}_i\right) + \left(1 - Y_i\right)\ln\left(1 - \hat{\pi}\right)\right]\right\}^{1/2}$$

The standardized and deviance residuals are the most commonly used statistic in identifying points for which the model fits poorly. Observations with absolute residual values in excess of 3 may indicate lack of fit.

Leverage Value

Detecting outliers is common practice and it is important to distinguish between two types of outliers. Outliers in the response variable represent model failure. Such observations are called outliers. Outliers with respect to the predictors are called leverage points. They can affect the regression model, too. Their response variables need not be outliers. However, they may almost uniquely determine regression coefficients. They may also cause the standard errors of regression coefficients to be much smaller than they would be if the observation were excluded.

Leverage is a term used in connection with regression analysis and, in particular, in analyses aimed at identifying those observations which have a large effect on the outcome of fitting regression models. Leverage points are those observations, if any, made at extreme or outlying values of the independent variables such that the lack of neighboring observations means that the fitted regression model will pass close to that particular observation. Leverage value is given by:

$$H = \hat{W}^{1/2} X\left(X'\hat{W}X\right)^{-1} X'\hat{W}^{1/2}$$

h_{ii} is the i^{th} diagonal element of the nxn estimated hat matrix H, whereby in logistic regression it is called hat diagonal or Pregibon leverage and measures the leverage of an observation. More clearly leverage is a measure of the importance of an observation to the fit of the model. Here, $\hat{W}$ is the nxn diagonal matrix with elements $\hat{\pi}_i\left(1-\hat{\pi}_i\right)$, X is the nx (k+1) design matrix.

Influential Statistics

Cook's Distance

Cook's D (Cook, 1977; Cook and Weisberg, 1982) is designed to measure the shift in $\hat{\beta}$ when a particular observation is omitted. It is a combined measure of the impact of that observation on all regression coefficients.

Cook's D is defined as

$$D_i = \frac{\left(\hat{\beta}_i - \hat{\beta}\right)(X'X)\left(\hat{\beta}_i - \hat{\beta}\right)}{p's^2}$$

Computationally, D_i is more easily obtained as

$$D_i = \frac{r_i^2}{p'}\left(\frac{v_{ii}}{1-v_{ii}}\right)$$

Where r_i is the standardized residual and v_{ii} is the i^{th} diagonal element of P computed from the full regression. Notice that D_i is large if the standardized residual is large and if the data point is far from the cancroids of the X-space that is, if v_{ii} is large.

The Cook's distance statistic assesses the influence of individual cases and is a measure of the change in the regression coefficient if an observation is deleted from the model.

Cook's distance considers the influence of the i^{th} value on all n fitted values and not on the fitted value of the i^{th} observation. It yields the shift in the estimated parameter from fitting a regression model when a particular observation is omitted. All distances should be roughly equal; if not, then there is reason to believe that the respective case(s) biased the estimation of the regression coefficients. Relatively large Cook statistics (or Cook's distance) indicates influential observations. This may be due to a high leverage, a large residual or their combination. There are different opinions regarding what cut-off values to use for spotting outliers. A simple operational guideline of $D_i > 1$ has been suggested.

DFBETAS: Cook’s distance reveals the impact of the i[th] observation on the entire vector of the estimated regression coefficients. The influential observations for the individual regression coefficients are identified by DFBETASj(i), j = 0, 1, 2, . . . , p, where each DFBETASj(i) is the standardized change in $\hat{\beta}_j$ when the i[th] observation is deleted from the analysis. Thus,

$$DFBETAS_{j(i)} = \frac{\hat{\beta}_j - \hat{\beta}_{j(i)}}{s_i \sqrt{c_{jj}}}$$

Where c_{jj} is the (j + 1) st diagonal element from $(X'X)^{-1}$. DFBETAS $_{j\ (i)}$ measures the change in $\hat{\beta}_j$ in multiples of its standard error. Although this looks like a t-statistic, it should not be interpreted as a test of significance. Values of DFBETASj(i) greater than 2 would certainly indicate a major, but very unlikely, impact from a single point. The cutoff point of $2/\sqrt{n}$ is suggested by Belsley, Kuh, and Welsch (1980) as the point that will tend to highlight the same proportion of influential points across data sets.

Chapter four

Results and discussion

In this chapter, we are going to analyze cultural, socio-economic and demographic factors that have impact on female genital circumcision in Ethiopia. The data used in this study for the analysis were obtained from the 2005 Ethiopian Demographic and Health Survey (EDHS) with reference to a total of 14,070 women in the age group 15-49 years. The dependent variable is a dichotomous random variable "Circumcision status" (coded as 1) and "not circumcised" (coded as 0). Descriptive and binary logistic regression methods are used to measure the effects of the determinants of female genital circumcision in Ethiopia. The descriptive part provides percentages of circumcision status of Ethiopian women. The binary logistic analysis is employed to assess the factors that have influence on female genital circumcision and to predict the odds of female genital circumcision in Ethiopia. The data are analyzed using the Statistical Package for Social Sciences (SPSS) version 13.

4.1 Descriptive statistics

Table 4.1: Demographic, socioeconomic and cultural characteristics of female genital circumcision in Ethiopia

		Circumcised			
		No		Yes	
		Count	Row N %	Count	Row N %
Mothers age	15-19	255	30.9%	571	69.1%
	20-24	450	27.4%	1194	72.6%
	25-29	504	23.9%	1603	76.1%
	30-34	378	23.6%	1224	76.4%
	35-39	308	20.4%	1200	79.6%
	40-44	206	18.5%	910	81.5%
	45-49	190	18.5%	838	81.5%
Region	Tigray	552	63.9%	312	36.1%
	Afar	39	5.8%	639	94.2%
	Amhara	384	25.3%	1136	74.7%
	Oromiya	113	6.9%	1520	93.1%
	Somali	13	2.4%	536	97.6%
	Ben-Gumz	230	33.4%	459	66.6%
	SNNP	366	24.8%	1108	75.2%
	Gambela	412	69.1%	184	30.9%
	Harari	32	5.7%	525	94.3%
	Addis Abeba	131	17.7%	608	82.3%
	Dire Dawa	19	3.6%	513	96.4%
place of residence	Urban	415	18.6%	1818	81.4%
	Rural	1876	24.7%	5722	75.3%
Religion	Coptic Orthodox	1324	30.0%	3086	70.0%
	Catholic	22	24.7%	67	75.3%
	Protestant	601	38.0%	979	62.0%
	Moslem	201	5.7%	3314	94.3%
	Traditional	101	70.6%	42	29.4%
	Other	42	44.7%	52	55.3%
Frequency of listening to radio	Not at all	1493	25.4%	4376	74.6%
	Less than once a week	473	19.7%	1934	80.3%

	At least once a week	60	21.5%	219	78.5%
	Almost every day	265	20.8%	1011	79.2%
Mother level of education	No education	1271	22.1%	4489	77.9%
	Primary	543	24.4%	1679	75.6%
	Secondary	396	26.4%	1102	73.6%
	Higher	81	23.1%	270	76.9%
wealth index	poor	1073	27.3%	2858	72.7%
	middle	390	24.5%	1200	75.5%
	rich	828	19.2%	3482	80.8%
Partner's occupation	Did not work	18	19.8%	73	80.2%
	Prof., Tech., Manag.	118	24.0%	373	76.0%
	Clerical	5	11.9%	37	88.1%
	Sales	216	20.4%	845	79.6%
	Agric-employee	1681	23.8%	5387	76.2%
	Services	59	26.6%	163	73.4%
	Skilled manual	104	20.9%	393	79.1%
	Unskilled manual	90	25.1%	269	74.9%

From the above descriptive statistics in Table 4.1, we see that circumcision status of daughters varies for each mother's age group. The highest prevalence rate (81.5%) of circumcised daughters was observed for mothers in the age group 40-44 and the percentage of not circumcised daughters in the same mothers age group was 18.5%. On the other hand the lowest prevalence rate (69.1%) of circumcised daughters and 30.9% of not circumcised daughters were observed for mothers in the age group 15-19.

Likewise, as Table 4.1 shows, circumcision rate varied from one region to another. For instance, the highest rate (97.6%) of circumcision of daughters was observed for mothers in Somali region followed by Afar region (94.2%). The lowest rate (36.1%) of circumcised daughters was observed for mothers in Tigray region. Circumcision differs by place of residence. The highest rate (81.4%) of circumcised daughters was for mothers living in rural area while only 18.6% of not circumcised daughters were for mothers living in rural area. Also 75.3% of circumcised daughters were for mothers living in urban area.

With regards to religion, 94.3% of daughters of Moslem mothers were circumcised followed by 75.3% of daughters of catholic mothers were circumcised. On the other hand, the highest proportion (70.6%) of not circumcised daughters was observed for those mothers with traditional religion as opposed to mothers following traditional religion where the lowest daughters' circumcision rate (29.4%) was recorded.

Moreover, 80.3% of circumcised daughters had mothers who are listening to radio less than once a week. Further, the highest percentages (77.9%) of daughters of mothers with no education were found to be circumcised. Wealth index also had its effect on circumcision status of daughters. The results indicate that 72.7% of circumcised daughters are born to poor mothers. Partner’s occupation is another important variable for circumcision status of daughters. We can see from the descriptive statistics that 80.2% of partners' of mothers of circumcised daughters’ had no work.

4.2 Logistic Regression

Table 4.2: Case Processing Summary

Unweighted Cases(a)		N	Percent
Selected Cases	Included in Analysis	9831	100.0
	Missing Cases	0	.0
	Total	9831	100.0
Unselected Cases		0	.0
Total		9831	100.0

a If weight is in effect, see classification table for the total number of cases.

Table 4.3 Dependent Variable Encoding

Original Value	Internal Value
No	0
Yes	1

Block 0: Beginning Block

Table 4.4.Classification Table (a, b)

observed			predicted		
			Circumcised		Percentage Correct
			No	Yes	
Step 0	Circumcised	No	0	2291	.0
		Yes	0	7540	100.0
	Overall Percentage				76.7

a. Constant is included in the model.
b .The cut value is .500

The block 0 output is for a model that includes only the intercept (constant). Given the base rates of the two circumcision status (options) i.e. the fact that (2291/9831 = 23.3% were not circumcised, while 76.7% were circumcised), and no other available information, the best strategy is to predict, for every case, that the subject is circumcised. Using that strategy, we would be correct 76.7% of the time.

Table 4.5: Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	1.191	.024	2493.404	1	.000	3.291

Under Variables in the Equation, we see that the intercept-only model

ln (odds) = 1.191, and exponentiating, we get the predicted odds ratio

[Exp (B)] = 3.291. That is, the predicted odds of being circumcised are 3.291.

Table 4.6: Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	age	72.138	1	.000
		region	29.996	1	.000
		residence	35.998	1	.000
		religion	284.804	1	.000
		radio	20.635	1	.000
		Mother level of education	10.320	1	.001
		wealth	75.564	1	.000
		Partner occupation	1.501	1	.220
	Overall Statistic		622.436	8	.000

The results of the Score test in Table 4.6 are used to predict whether or not an independent variable would be significant in the model. Looking at the p-values (located in the column labeled "Sig."), we can see that all of the predictors except partner's occupation are statistically significant at significance level 0.05.

The overall statistic shows the result of including all of the predictors into the model. We see that it is significant at 0.05 level.

Block 1: Method = Enter

Table 4.7: Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	650.441	8	.000
	Block	650.441	8	.000
	Model	650.441	8	.000

When we look at the Block 1 output, the Omnibus Tests of Model Coefficients gives us a Chi-Square value of 656.180 with 8 *df*, significant at 0.05 level. This is a test of the null hypothesis that adding the predictors to the model has not significantly increased our ability to predict the circumcisions made on our subjects. From the above result of omnibus tests, it is significant at 0.05 level implying that adding the predictors has significantly increased our ability to predict Circumcsion.

Table 4.8 Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	10024.484(a)	.064	.097

a .Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

Under Model Summary we see that the value of -2 Log Likelihood statistic is 10024.484. This statistic measures how poorly the model predicts Circumcsion, the smaller the statistic the better the model. Although SPSS does not give us this statistic for the model that had only the intercept, we know it to be 10674.925(10024.484+650.441). Adding the predictors reduced the -2 Log Likelihood statistic by 10674.925 – 10024.484 = 650.441. The Cox and Snell R^2 can be interpreted like R^2 in a multiple regression, but cannot reach a maximum value of 1. The Nagelkerke R^2 can reach a maximum of 1.

Table 4.9: Hosmer - Lemeshow Test

Step	Chi-square	df	Sig.
1	27.976	8	0.745

Table 4.10 Contingency Table for Hosmer and Lemeshow Test

		Circumcised = No		Circumcised = Yes		Total
		Observed	Expected	Observed	Expected	
Step 1	1	743	718.884	229	253.116	972
	2	456	506.282	530	479.718	986
	3	292	320.582	692	663.418	984
	4	275	249.893	710	735.107	985
	5	223	190.078	760	792.922	983
	6	133	132.335	845	845.665	978
	7	278	79.570	706	904.430	984
	8	144	47.089	839	935.911	983
	9	231	29.451	779	980.549	1010
	10	116	16.836	850	949.164	966

The Hosmer-Lemeshow test tests the null hypothesis that there is a linear relationship between the predictor variables and the log odds of the criterion variable. Cases are arranged in order of their predicted probability on the criterion variable. These ordered cases are then divided into ten groups (lowest decile [prob < .1] to highest decile [prob > .9]). Each of these groups is then divided into two groups on the basis of actual score on the criterion variable. This results in a 2 x 10 contingency table. Expected frequencies are computed based on the assumption that there is a linear relationship between the weighted combination of the predictor variables and the log odds of the criterion variable. A chi-square statistic is computed comparing the observed frequencies with those expected under the linear model assumption. A nonsignificant chi-square indicates that the data fit the model well. This means we do not reject the null hypothesis that there is a linear relationship between the predictor variables and the log odds of the criterion variable.

Table 4.11 Classification Table (a)

Observed			Predicted		
			Circumcised		Percentage Correct
			No	Yes	
Step 1	Circumcised	No	1037	1254	45.3
		Yes	486	7054	93.6
	Overall Percentage				82.3

a. The cut value is .500

The Classification Table shows that this rule allows to correctly classify 7054/ 7540 = 93.6% of the subjects where the predicted event (circumcised) was observed. This is known as the sensitivity of prediction, the P (correct | event did occur), that is, the percentage of occurrences correctly predicted. We also see that this rule allows us to correctly classify 1037/ 2291 = 45.3% of the subjects where the predicted event was not observed. This is known as the specificity of prediction, the P (correct | event did not occur), that is, the percentage of nonoccurrence correctly predicted. Overall our predictions were correct 8091 out of 9831 times, for an overall success rate of 82.3%.

We also focus on error rates in classification. A false positive would be predicting that the event would occur when, in fact, it did not. Our decision rule predicted not circumcised are 1523 times. That prediction was wrong 62 times, for a false positive rate of 486 / 1523 = 31.9%. A false negative would be predicting that the event would not occur when, in fact, it did occur. Our decision rule predicted circumcised is 8308 times. That prediction was wrong 2231 times, for a false negative rate of 1254/ 8308 = 15%.

Table 4.12 Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1(a)	age	.106	.014	55.193	1	.000	1.112
	region	-.015	.007	4.507	1	.034	.985
	residence	-.477	.090	28.162	1	.000	.621
	religion	.384	.020	383.708	1	.000	1.468
	radio	.127	.030	17.753	1	.000	1.136
	Mothers' level of education	-.303	.037	67.320	1	.000	.739
	wealth	.367	.035	109.125	1	.000	1.443
	Partner occupation	-.015	.015	.968	1	.325	.985
	Constant	.294	.237	1.537	1	.215	1.341

a Variable(s) entered on step 1: age, region, residence, religion, radio, mother level of education, wealth, p.occupation.

The final logistic regression equation is given as

Ln(odds)=0.390+0.106Age-0.015Region-0.477Residence+0.384Religion

+0.127Radio -0.303mother edu+0.367Wealth

The estimates in Table 4.12 tell the relationship between the independent variables and the dependent variable, where the dependent variable is on the logit scale.

The columns for Wald and Sig. provide the Wald chi-square value and p-value (significance) used in testing the null hypothesis that the coefficient (parameter) is 0. Coefficients having p-values less than alpha (α=0.05) are statistically significant. Table 4.12 shows that all variables except partner occupation are significant at α=0.05 level.

4.13 Results of the binary logistic regression model

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1(a)	age			63.445	6	.000	
	age(1)	-.793	.133	35.505	1	.000	.452
	age(2)	-.560	.116	23.157	1	.000	.571
	age(3)	-.392	.113	12.019	1	.001	.676
	age(4)	-.340	.118	8.376	1	.004	.712
	age(5)	-.116	.120	.932	1	.334	.891
	age(6)	-.067	.129	.271	1	.603	.935
	region			1035.944	10	.000	
	region(1)	-3.570	.262	185.635	1	.000	.028
	region(2)	-1.029	.300	11.754	1	.001	.357
	region(3)	-2.053	.259	63.093	1	.000	.128
	region(4)	-.521	.268	3.785	1	.052	.594
	region(5)	-.232	.378	.377	1	.539	.793
	region(6)	-2.550	.263	93.896	1	.000	.078
	region(7)	-1.579	.262	36.471	1	.000	.206
	region(8)	-3.461	.267	167.526	1	.000	.031
	region(9)	-.652	.302	4.669	1	.031	.521
	region(10)	-1.357	.259	27.533	1	.000	.258
	residence(1)	-.310	.108	8.209	1	.004	.734
	religion			350.524	5	.000	
	religion(1)	.814	.237	11.752	1	.001	2.257
	religion(2)	.767	.362	4.504	1	.034	2.154
	religion(3)	.222	.236	.880	1	.348	1.248
	religion(4)	1.970	.243	65.554	1	.000	7.173
	religion(5)	-1.425	.306	21.644	1	.000	.240
	radio			8.417	3	.038	
	radio(1)	.117	.103	1.285	1	.257	1.124
	radio(2)	.262	.104	6.371	1	.012	1.299
	radio(3)	.297	.185	2.584	1	.108	1.346
	Mother level of education			10.503	3	.015	
	mother level of education(1)	.352	.170	4.285	1	.038	1.422
	Mother level of education(2)	.271	.170	2.549	1	.110	1.311
	Mother level of education(3)	.045	.163	.076	1	.783	1.046
	wealth			40.643	2	.000	
	wealth(1)	-.514	.081	39.989	1	.000	.598

wealth(2)	-.249	.090	7.599	1	.006	.779
Partner occupation			6.487	7	.484	
Partner occupation(1)	-.019	.337	.003	1	.955	.981
Partner occupation(2)	.037	.197	.035	1	.852	1.037
Partner occupation(3)	1.147	.557	4.234	1	.040	3.148
Partner occupation(4)	.163	.175	.870	1	.351	1.177
Partner occupation(5)	.054	.154	.121	1	.728	1.055
Partner occupation(6)	.154	.237	.426	1	.514	1.167
Partner occupation(7)	.168	.197	.727	1	.394	1.183
Constant	2.325	.417	31.055	1	.000	10.222

a. Variable(s) entered on step 1: age, region, residence, religion, radio, p.education, wealth, p.occupation.

Interpretation of odds ratio

We can interpret the odds ratio of age obtained in the above table using the reference category mother's age group 45-49. The odds of daughters being circumcised has decreased by a factor of 0.452 for mothers in the age group 15-19 compared to those in the age group 45-49 controlling for other variables in the model. Similarly, the odds of daughters being circumcised decreased by a factor of 0.571 for mothers in the age group 20-24 compared to those in the age group 45-49 controlling other variables in the model.

For the second variable, region, the reference category is Dire Dawa. The odds of daughters being circumcised has decreased by a factor of 0.028 for mothers living in Tigray compared to those in Dire Dawa controlling for other variables in the model. Similarly, the odds of daughters being circumcised has decreased by a factor of 0.357for mothers living in Afar compared to Dire Dawa controlling for other variables in the model.

For the variable place of residence, the reference category is rural, the odds of daughters being circumcised has decreased by a factor of 0.734 for mothers living in urban compared to those in the rural area controlling for other variables in the model.

For the variable religion the reference category is others, the odds of daughters being circumcised is 2.257 times higher for orthodox compared to others controlling for other variables in the model. And for the second category the odds of daughters being circumcised is 2.154 times higher for catholic compared to others controlling for other variables in the model.

For the variable frequency of listening radio, the reference category is almost every day, the odds of daughters being circumcised is 12.4% higher for women that are not at all listening to the radio compared to those listening almost every day controlling for other variables in the model. Similarly, the odds of daughters being circumcised is 29.9% higher for mothers that were listening to the radio for less than once a week compared to those listening almost every day controlling for other variables in the model. The odds of daughters being circumcised is 34.6% higher for women listening to radio for at least once a week compared to those listening almost every day controlling for other variables in the model.

For the variable mothers' level of education, the reference category is higher education, the odds of having circumcised daughter is 42.2% higher for mothers with no education compared to those with higher education controlling other variables in the model.

For the variable wealth, the reference category is rich and the odds of daughters being circumcised has decreased by a factor of 0.598 for poor mothers compared to rich mothers controlling for other variables in the model.

Model diagnosis

The fitted model was checked for possible presence of outliers and influential values .The diagnostics test results for detection of outliers and influential values are presented in Appendix B.

Thus, a check of the standardized and deviance residuals reveals that all have values within ±3 indicating the absence of outliers in the model. And a check of DFBETA reveals that all have values less than $\frac{2}{\sqrt{n}}$, n is the number of women's included in the analaysis that is 9831, thus, we have $\frac{2}{\sqrt{n}}$=0.02 indicating the absence of outliers in the model. In addition, there are no unusually high values of Cook's distance which means that there are no influential cases having an effect on the model. Therefore, the model is adequate.

CHAPTER FIVE

DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 DISCUSSION AND CONCLUSIONS

Female genital cutting (FGC), also known as female genital mutilation (FGM), female circumcision, is any procedure involving the partial or total removal of the external female genital organ whether for cultural, religious or other non – therapeutic reasons. The procedure is generally carried out on girls between the ages of 4 and 14; it is also done on infants, women who are about to be married and, sometimes, to women who are pregnant with first child or who have just given birth. It is often performed by traditional practitioners, including midwives and barbers, without anesthesia, using scissors, razor blades or broken glass. FGC is always traumatic. Immediate complications include excruciating pain, shock, urine retention, ulceration of the genitals and injury to adjacent tissue. Other complications include blood poisoning, infertility and obstructed labor and infections have caused death. Therefore, understanding the factors that influence FGC is critical to stop this harmful practice. [Arbesman M (1993)]

From the result of descriptive and logistic regression, female circumcision differs by educational level. Mother's level of education appears to be an important determinant of female genital circumcsion status of daughters. Higher educated women do not want their daughters to be circumcised. If mothers have no education, their daughters are highly exposed to FGC. This might be due to the fact that when education increases awareness about the consequences of female circumcision increases leading to a decrease in the practice of female circumcision. From the literature, higher educational attainment is associated with a more negative attitude towards FGC. This implies community education would be critical for FGC eradication (Gage and Van Rossem 2005).

Female circumcision differs by region. Circumcision is highly practiced in Somali and Dire Dawa compared to other regions, the lowest circumcision is observed in Gambela and Tigray regions. An important reason is that men prefer marriage to circumcised women and mothers worry about their daughters thinking that an uncircumcised girl would not be married and becoming less attractive to men (Missailidis , Gebre-Medhin :2000)

According to our findings, religion has been found a significant variable for female circumcision. Our findings show that the highest proportion of circumcision is performed among Moslems. On the other hand circumcision rate is low among followers of traditional religions. It could be that religion has an immense social, economic, and political significance in most societies, and thus plays an important role in sanctioning or promoting acceptance of or creating resistance to circumcision. Similar studies have also shown that female genital cutting (FGC) is often assumed to be strongly associated with Islam (Hayford and Trinitapoli 2009)

Place of residence is found to be another significant variable for FGC. Female who live in rural areas are more likely to have their daughters circumcised compared to females in urban areas. Women who live in urban areas have information from health facilities, professionals and hearing about FGC through mass media.

Age of mother is also an important variable for circumcision status. The rate of circumcision is highest for the age group 45-49. This indicates that at higher ages the perception of mothers about FGC is low. On the other hand, in the age group 15-19 there is low rate of circumcision. The finding of this study is similar with other studies reported by Rahlenbeck and Mekonnen (2009) where it was indicated that prevalence of FGC in daughters decreased with decreasing maternal age.

Wealth index has also been found to be a significant variable for circumcision. Circumcisions among daughters of rich women is higher when compared to daughters of poor women. This is contrary to our perception that high circumcision rate is found in families having low economic status.

Frequency of listening to radio is another important variable for circumcision. Most circumcised daughters are from mothers who listen to the radio less than once a week. Radio programs about circumcision are not currently satisfactory. This implies that the female may have access to listening radio but if there are no special programs about circumcision, listening to radio daily will not improve their knowledge and awareness about FGC.

5.2 RECOMMENDATIONS

On the basis of our findings, we recommend the following

- Enhance information and communication activities regarding Female circumcision using mass media and health centers. Furthermore, mass Media like radio must give special programs about circumcision.
- Special attention should be given to regions where this kind of harmful practice is performed.
- Special attention should be given to rural areas where female circumcision is practiced.
- Policies and laws against female genital circumcision that support religious and community leaders in the campaign to fight the practice must be developed.
- Education about circumcision should be given to households decision-makers particularly for women.

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Appendix

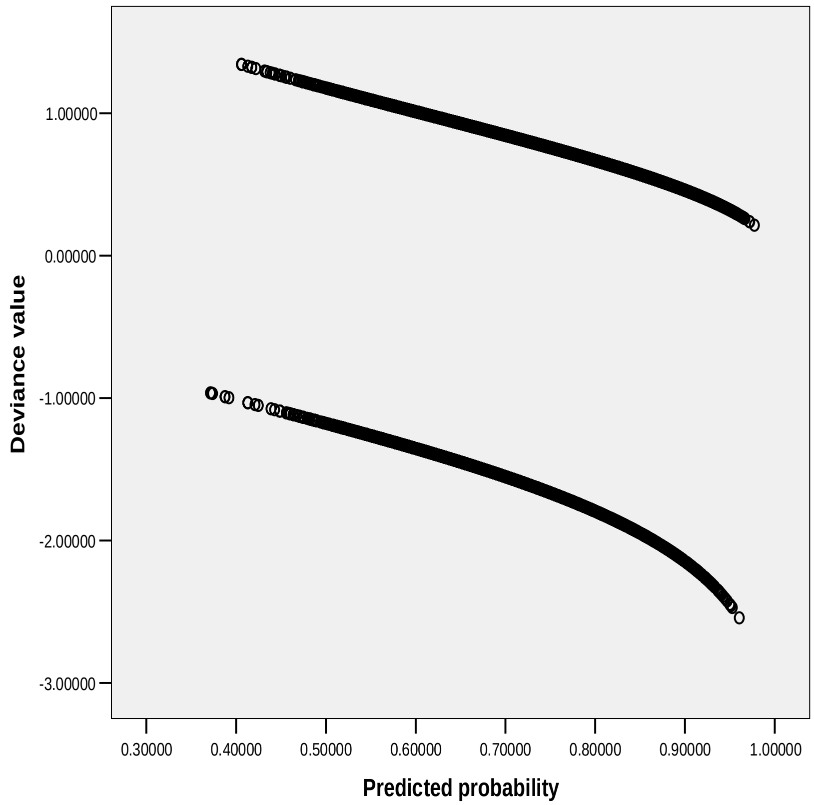
Table A: Categorical Variables Coding

		Frequency	Parameter coding									
			(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Region	Tigray	864	1.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	Afar	678	.000	1.000	.000	.000	.000	.000	.000	.000	.000	.000
	Amhara	1520	.000	.000	1.000	.000	.000	.000	.000	.000	.000	.000
	Oromiya	1633	.000	.000	.000	1.000	.000	.000	.000	.000	.000	.000
	Somali	549	.000	.000	.000	.000	1.000	.000	.000	.000	.000	.000
	Ben-Gumz	689	.000	.000	.000	.000	.000	1.000	.000	.000	.000	.000
	SNNP	1474	.000	.000	.000	.000	.000	.000	1.000	.000	.000	.000
	Gambela	596	.000	.000	.000	.000	.000	.000	.000	1.000	.000	.000
	Harari	557	.000	.000	.000	.000	.000	.000	.000	.000	1.000	.000
	Addis Abeba	739	.000	.000	.000	.000	.000	.000	.000	.000	.000	1.000
	Dire Dawa	532	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
Partner's occupation	Did not work	91	1.000	.000	.000	.000	.000	.000	.000			
	Prof., Tech., Manag.	491	.000	1.000	.000	.000	.000	.000	.000			
	Clerical	42	.000	.000	1.000	.000	.000	.000	.000			
	Sales	1061	.000	.000	.000	1.000	.000	.000	.000			
	Agric-employee	7068	.000	.000	.000	.000	1.000	.000	.000			
	Services	222	.000	.000	.000	.000	.000	1.000	.000			
	Skilled manual	497	.000	.000	.000	.000	.000	.000	1.000			
	Unskilled manual	359	.000	.000	.000	.000	.000	.000	.000			
Age 5-year groups	15-19	826	1.000	.000	.000	.000	.000	.000				
	20-24	1644	.000	1.000	.000	.000	.000	.000				
	25-29	2107	.000	.000	1.000	.000	.000	.000				
	30-34	1602	.000	.000	.000	1.000	.000	.000				
	35-39	1508	.000	.000	.000	.000	1.000	.000				
	40-44	1116	.000	.000	.000	.000	.000	1.000				
	45-49	1028	.000	.000	.000	.000	.000	.000				
Religion	Orthodox	4410	1.000	.000	.000	.000	.000					
	Catholic	89	.000	1.000	.000	.000	.000					
	Protestant	1580	.000	.000	1.000	.000	.000					
	Moslem	3515	.000	.000	.000	1.000	.000					
	Traditional	143	.000	.000	.000	.000	1.000					
	Other	94	.000	.000	.000	.000	.000					
Frequency of listening to	Not at all	5869	1.000	.000	.000							

radio												
	Less than once a week	2407	.000	1.000	.000							
	At least once a week	279	.000	.000	1.000							
	Almost every day	1276	.000	.000	.000							
Mother level of education	No education	5760	1.000	.000	.000							
	Primary	2222	.000	1.000	.000							
	Secondary	1498	.000	.000	1.000							
	Higher	351	.000	.000	.000							
wealth index	poor	3931	1.000	.000								
	middle	1590	.000	1.000								
	rich	4310	.000	.000								
place of residence	Urban	2233	1.000									
	Rural	7598	.000									

Table B: Results of diagnostics tests for outliers and influential values

	N	Minimum	Maximum
Analog of Cook's influence statistics	9831	.00001	.02276
Leverage value	9831	.00024	.01047
Standard residual	9831	-2.54359	1.34422
Deviance value	9831	-2.54264	1.34272
DFBETA for constant	9831	-.01829	.01363
DFBETA for mother age	9831	-.00072	.00067
DFBETA for region	9831	-.00031	.00050
DFBETA for residence	9831	-.00520	.00844
DFBETA for religion	9831	-.00165	.00053
DFBETA for radio	9831	-.00238	.00153
DFBETA for mother level of education	9831	-.00249	.00282
DFBETA for wealth	9831	-.00212	.00216
DFBETA for p.occupation	9831	-.00087	.00103
Valid N (list wise)	9831		


Deviance value
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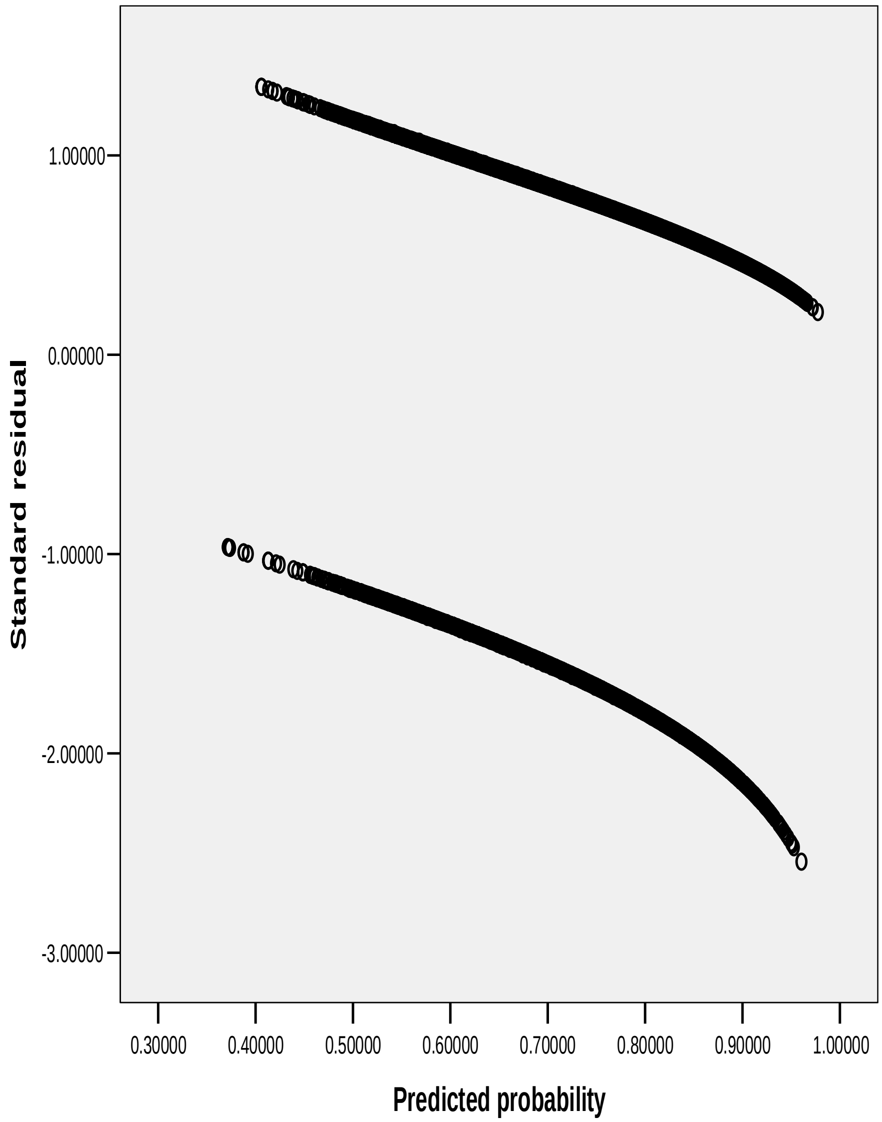
0.00000
-1.00000
-2.00000
-3.00000
0.30000
0.40000
0.50000
0.60000
0.70000
0.80000
0.90000
1.00000
Predicted probability



Standard residual
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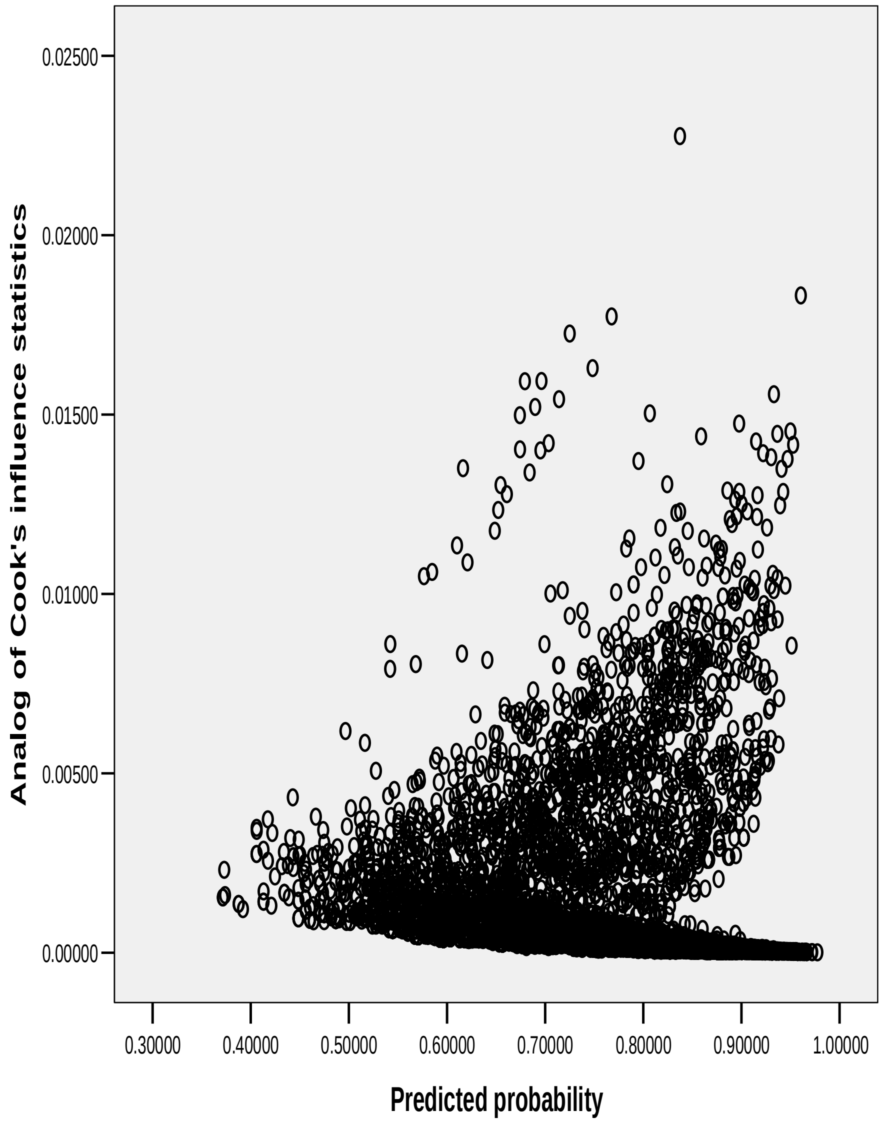
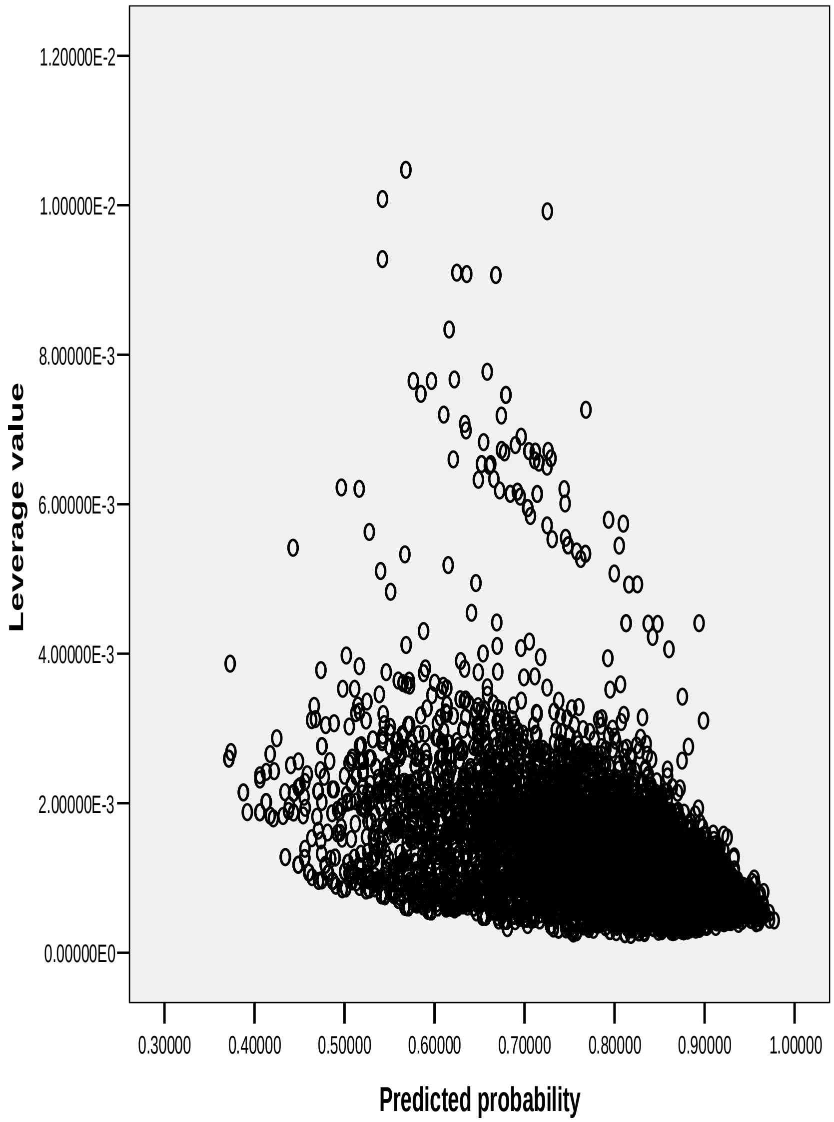
0.00000
-1.00000
-2.00000
-3.00000
0.30000
0.40000
0.50000
0.60000
0.70000
0.80000
0.90000
1.00000
Predicted probability


Analog of Cook's influence statistics
0.02500
0.02000
0.01500
0.01000
0.00500
0.00000
0.30000
0.40000
0.50000
0.60000
0.70000
0.80000
0.90000
1.00000
Predicted probability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1.00000E-2
8.00000E-3
6.00000E-3
4.00000E-3
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0.00000E0
Leverage value
0.30000
0.40000
0.50000
0.60000
0.70000
0.80000
0.90000
1.00000
Predicted probability

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I, the undersigned, declare that the thesis is my original work, has not been presented for a degree in any other university and that all sources of material used for the thesis have been duly acknowledged.

Declared by

Name: **Roman Assefa**

Signature: ______________________________

Date: June_____________

This thesis has been submitted for examination with my approval as a University Advisor.

Name: **Ato Mekonnen Tadesse (Assistant Professor)**

Signature: ______________________________

Date: June_______________