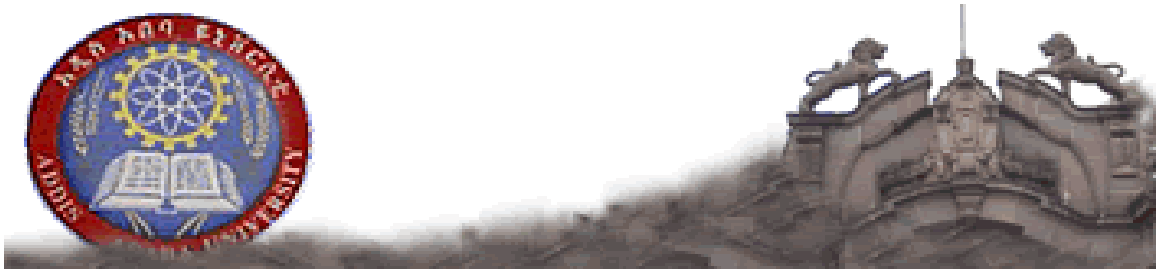

ADDIS ABABA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

DEPARTMENT OF STATISTICS

DETERMINANTS OF FAMILY PLANING PRACTICE AMONG WOMEN OF REPRODUCTIVE AGE IN ETHIOPIA

(Application of multilevel logistic model)

BY

SELAMAWIT SISAY

A Thesis submitted to the Office of Graduate Programs of Addis Ababa University in Partial fulfillment of the requirements for the Degree of Master Science in Statistics

Addis Ababa University

Addis Ababa, Ethiopia

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Advisor: Prof. M.K.Sharma

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School of Graduate Studies

This is to certify that the thesis prepared by Selamawit sisay, entitled: **DETERMINANTS OF FAMILY PLANING PRACTICE AMONG WOMEN OF REPRODUCTIVE AGE IN ETHIOPIA** and submitted in partial fulfillment of the requirements for the Degree of Master of Science in Statistics complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

Signed by the Examining Committee:

Examiner _____ Signature _____Date _____

Examiner _____ Signature _____Date _____

Advisor _____ Signature _____Date _____

Chair of Department or Graduate Program Coordinator

DECLARATION

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

Name: Selamawit Sisay

Signature: _____

Place of submission: Department of Statistics, Collage of Natural Science, Addis Ababa University

Date of submission: July, 2015

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

Prof. M.K.Sharma _____

Advisor's Name signature

Table of Contents

ABSTRACT

Determinants of Family Planning Practice among Women of reproductive age in Ethiopia

Selamawit Sisay

Addis Ababa University, 2015

Ethiopia is the second most populous nation in Africa. Family planning is a viable solution to control such fast growing population. In Ethiopia, women have, on average, about five children and surveys show that the unmet need for family planning services is high. This study aimed to identify factors that affect women's family planning practice in Ethiopia. In this study the data source is EDHS 2011 with a total of 16515 women of age 15-49 years. In this study 10176 all women of reproductive age are considered. Descriptive statistics, binary logistic regression and multilevel logistic regression are used for statistical analysis. The descriptive result revealed that about 15.3% of the women practiced family planning while 84.7 % did not practice family planning. The logistic regression analysis revealed that region, place of residence, age of a woman, religion of a woman, educational level of women, economic status, knowledge about FP method, visited by FP worker in the last 12 months before the survey, occupation of women, marital status, ability to refuse sex, exposure to mass media and number of living children of women were found to be significant predictors for women's family planning practice. The estimates of the multilevel analysis showed that variables that are reported to be significant in binary logistic regression analysis were also found to be significant. The effect of these significant variables is the same for each region in Ethiopia except for place of residence and exposure to mass media on women's FP practice which were not the same for each region in Ethiopia.

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Finally I would like to express my deepest gratitude to the department of statistics as well as Addis Ababa University for giving this opportunity by sponsoring me to complete my graduate study.

List of Abbreviations

- AIC-Akaike Information Criteria
- BIC-Bayesian Information Criteria
- CI- Confidence Interval
- CPR-contraceptive prevalence rate
- CSA-Central Statistical Agency
- DHS- Demographic and Health Survey
- FP-Family Planning
- GLIMMIX- Generalized Linear Mixed Model
- LR- Likelihood Ratio
- ML- Maximum Likelihood
- MQL- Marginal Quasi Likelihood
- OLS- Ordinary Least Square
- PQL- Penalized Quasi Likelihood
- S.E- Standard Error
- SNNP- South Nations, Nationality and People
- SPSS-statistical package for social science
- TV -television
- UK- United Kingdom
- UNICEF-United Nations International Children Fund
- US- United State
- WHO- World Health Organization

List of Tables

CHAPTER ONE

1. INTRODUCTOIN

1.1. Back ground of the Study

Ethiopia being the second most populous nation in Africa after Nigeria is a prototype example of nations which has been facing multitudes of challenges following rapid population growth including environmental degradation, chronic food insecurity, high maternal, and child mortality (EDHS, 2011). With a 2014 population of approximately 96.5 million and nearly 2.58 million increase its population is estimated to be 98.9 million at the end of 2015(WPR, 2014). The total fertility rate of Ethiopia is 5.23 children per woman, population growth rate is estimated at 2.89% per year, contraceptive prevalence rate (CPR) is only 28.6% and an unmet need for family planning is 34 percent. If Ethiopia follows its current rate of growth, its population will double in the next 20 years and cross 300 million by 2050. Most of the world's population growth in the next 40-50 years is expected to come from Africa, and Ethiopia will be a large part of the growth (WPR, 2014). This puts Ethiopia among countries with highest total fertility rates in the world. For fertilities to fall to those low levels, increases the use of family planning methods plays a significant contribution especially in less developed countries including Ethiopia.

Globally, each year, nearly 350,000 women die while another 50 million suffer illness and disability from complications of pregnancy and child birth (Hogan et al., 2008). It has been reported that Ethiopia is one of among six countries that contribute to about 50% of the maternal deaths along with India, Nigeria, Pakistan, Afghanistan and the Democratic Republic of Congo (Hogan et al., 2008). The Ethiopia Demographic Health Surveys of 2000, 2005 and 2011 gave figures of 871, 673 and 676 per 100,000 live births maternal mortality ratios respectively (CSA, 2000 CSA, 2005 and CSA, 2011).

Family planning is the practice to prevent or avoid unwanted birth and control the spacing between child birth to help create a small and planned family. It is the best way to control the rapidly and massively growing population. So, family planning contributes to promote the health and welfare of the family and thus contribute effectively to the social development of a country. The health of mothers is not only affected by nutrition status but also by early marriage, frequent

pregnancies, early motherhood, abortion etc. Moreover, the health of a child is also affected by the mother‘s health status (WHO, 2013).

Family planning has a clear effect on the health of women, children, and families worldwide especially those in developing countries (Darrochet al., 2011). It offers women opportunities to plan and space pregnancies in order to achieve personal goals and self-sufficiency. It allows individuals to anticipate and attain their desired number of children and the spacing and timing of their births. Family planning has a direct impact on women‘s health and well-being as well as on the consequence of each pregnancy (WHO, 2011). Globally, contraceptives help to prevent an estimated 2.7 million infant deaths and the loss of 60 million of healthy life in a year (Darroch et al., 2011).

More over Promotion of family planning in countries with high birth rates has the potential to reduce poverty and hunger and avert 32% of all maternal deaths and nearly 10% of childhood deaths (Cleland et al, 2006).It would also contribute substantially to women‘s empowerment, achievement of universal primary schooling, and long-term environmental sustainability. Thus in addition to spacing and limiting the number of children it improves maternal and child health empowers women and enhances economic development (Ferdousi et al., 2010).

In developing countries millions of sexually active women of reproductive age (15-49) want to avoid pregnancy and delay child bearing for at least two years or want to stop pregnancy and limit their family size but have unmet need for FP (Darroch et al., 2011). Which implies even recognizing these benefits of FP Unmet Need for Family Planning remains high in the Least Developed Countries. Over the past 40 years, the emerging economies have experienced very rapid increases in their contraceptive coverage, enabling rather steady fertility declines. By contrast, the least developed countries, mostly located in sub-Saharan Africa, are just beginning to use modern contraceptives (Rwanda and Ethiopia are among the few exceptions). Unmet need for family planning remains high in sub-Saharan Africa. About 25 percent of women who would like to postpone their next birth by two years do not currently use a contraceptive method. This need could be met by improving contraceptive knowledge and the supply of reproductive health services so that women can better plan their families (Jean and John, 2013).

The factors that influence family planning practice are multifaceted and challenging. Several studies evident that most women's knowledge and practice of FP is associated with socio-demographic, socio-cultural, socio economic, source of information and family planning factors. For instance, according to different study findings socio-demographic and economic and media exposure related factors were found to contribute on the practice of FP (Mekonnen et al., 2011 Ibnouf et al., 2007 Mostafa et al., 2010).

At present, family planning service which is free of cost is provided in both governmental and NGO health facilities in Ethiopia, including hospitals, clinics, health centres, and health stations (UN, 2011). But, Ethiopia is among countries with low contraceptive prevalence rate, with only 29% (CSA, 2011). This resulted in high total fertility rate and unwanted pregnancy which intern affects the maternal and child health status (Hailemariam et al., 2006).

Considering the present lower utilization of contraceptives achieving the MDGs will be a major challenge for Ethiopia. Therefore, the identification of the possible factors that determine the practice of FP will have greater input to program managers for designing programs, proper implementation and evaluation of their contribution regarding family planning.

1.2. Statement of the problem

The vastly growing population is an issue all around the world especially in developing countries like Ethiopia. Ethiopia is the second most populous nation in Africa with estimated population of 96.5 million and growth rate of 2.89 percent. More over Ethiopia is one among the six countries that contribute to about 50% of the maternal deaths (Hogan et al., 2008). Thus practicing family planning is a viable and cost effective solution for such growing population and decreasing this high maternal mortality (Black et al., 2003).

Additionally the inclusion of FP in the Target 5b of the Millennium Development Goal (MDG) in 2005 reflects the international consensus on its benefits, both for mother and child at individual level and for family income, national economy and environment at collective level (Bongaarts & Sinding 2009; Cates 2010; Potts et al.2013).

In Ethiopia, women have, on average, about five children. Even though most of the women in Ethiopia knew at least one family planning method but their practice level was not that much which could be as a result of various things like their religion, education, wealth, knowledge of family planning and so on(CSA and Macro, 2006). Researches agreed that socio economic, demographic and other proximate factors influence the uptake of family practice among women.

Thus the main focus of this paper is to examine the major socio-economic, demographic, and other proximate factors that affect Family planning practice among women of reproductive age in Ethiopia.

1.3. Objective of the Study

1.3.1. General Objective

The general objective of this study is to identify factors that affect family planning practice among women of reproductive age and examine variations in family planning practice between and within regions based on EDHS (2011).

1.3.2. Specific Objective

- To identify socio-economic, demographic, behavioural and service factors that affect family planning practice of women of reproductive age in Ethiopia.

- To examine the extent of variation in family planning practice within and between regions of Ethiopia.

- To identify the factors that explains the variation in family planning practice between and within regions of Ethiopia.

1.4. Significance of the study

The main purpose of this study is to maximize the existing level of family planning practice and awareness of women by identifying areas with low FP practice.

The findings could also help women to have enough knowledge about the practice of family planning and initiate them to make decision regarding various contraceptive methods available. It is hoped that this study could contribute for the improvement of services associated with FP in Ethiopia through appropriate service delivery.

1.5. Limitation of the study

The data used here being secondary may have a number of limitations on the outcome of the study but the major limitation of this study was important variables such as fear of side effects, access to family planning service, quality of service delivered etc are not included in the analysis of this study because of missing values and non responses.

CHAPTER TWO

2. LITERATURE REVIEW

2.1. Overview of Family Planning

Family planning has been cited as essential to the achievement of Millennium Development Goals (MDG) and is an important indicator for tracking progress on improving maternal health (Eliason et al., 2013 and Cates et al., 2010). Family planning is one of four pillars with antenatal care, safe delivery, and postnatal care that was introduced by the Safe Motherhood Initiative in 1987 to reduce maternal mortality in developing countries, where 99% of all maternal deaths occur (Ahmed et al., 2012).

Contrary to popular belief, family planning does not coincide with abortion. The term ―family planning" covers a wide range of services concerning women, children, and their families. Family planning services can include access to birth control, contraceptives, sexual education, and other health resources. Access to family planning services can provide much needed reproductive resources such as birth control, contraceptives and prevention and treatment for STDS and HIV (Gold,et al., 2009). Family planning clinics are also sources of knowledge for birth spacing and help make known the benefits of spacing births (Gold et al., 2009). Access to family planning resources has led to the reduction of infant and maternal mortality, as well (Gold et al., 2009). The goal of family planning is to reduce unwanted births, teen pregnancy, spread of STDs and HIV, and improve the overall health of mother, child, and, ultimately, the family unit.

Family planning improves health, reduces poverty and empowers women (Bongaarts et al., 2012). Voluntary high-quality family planning programs speed fertility declines, thus improving health and boosting economies. Indeed, they are among the most cost-effective health and development investments available to governments (Bongaarts et al., 2012). The case for family planning has been made, yet more than 200 million women in the developing world who want to avoid pregnancy are not using a modern contraceptive method. The reasons for this are many, including lack of access to information and appropriate health services, traditional gender norms that impede women's ability to adopt contraception, real and perceived concerns about safety and side effects, and cost, among others. Underlying socio-behavioural issues, including risk perception, ambivalence, and social costs, may also play a role in demand and use.

Effective family planning program make the rapid spread voluntary modern family planning method possible in any country such program help people to achieve their personal reproductive goals. Family planning is identified by the world health organization (WHO) as one of the six essential health intervention needed to achieve safe mother hood and by united nation children found (UNCF) as one of seven strategies for child survival (John et al., 2010).

Family planning has a direct impact on women's health and well-being as well as on the consequence of each pregnancy (WHO, 2011). In the developing countries millions of women in the reproductive age who don't use contraceptives prefer to postpone or limit their birth. This indicates their failure to take necessary decision to prevent and avoid unwanted pregnancy (Malwenna et al., 2012)

2.2. Situation of Family Planning in Ethiopia

Ethiopia like, most countries in sub Sahara Africa, is experiencing rapid population growth. Currently the country's Population is growing at a rate of 2.89 percent, one of the highest rate in the World and if continues unabated, the population will have doubled in the next 20 years, preventing any gain in the nation development effort (WPR, 2014).

Ethiopia is one among the six countries that contribute to about 50% of the maternal deaths along with India, Nigeria, Pakistan, Afghanistan and the Democratic Republic of Congo (Hogan et al., 2008). The Ethiopia Demographic Health Surveys of 2000, 2005 and 2011 gave figures of 871, 673 and 676 per 100,000 live births maternal mortality ratios respectively (CSA, 2000 CSA, 2005 and CSA, 2011).

The modern family planning service in Ethiopia started in 1966 (EMOH, 2011_a) but showed little signs of expansion for an extended period of time. However, in the last 20 years, with the adoption of the population policy in 1993 (GOE, 1993 and TGOE, 1993), numerous local and international partners in family planning have come together to assist the government in expanding family planning programs and services. The National Population Office was established to implement and oversee the strategies and actions related to the population policy (EMOH, 2011_a).

In 1996, the Ministry of Health released Guidelines for Family Planning Services in Ethiopia to guide health providers and managers, as well as to expand and ensure quality family planning services in the country (MOH, 1996). The ministry designed new outlets for family planning services in the form of community-based distribution, social marketing, and work-based services, in addition to the pre-existing facility-based and outreach family planning services. Work-based services are services made available to users at their place of work such as factories, prisons, and schools (EMOH, 2011_a).

Moreover, in the last decade, integration and linkage between family planning services and HIV/AIDS care, along with maternal and other reproductive health services, have been emphasized in guidelines and strategic documents with the aim of enhancing family planning utilization (EMOH, 2011_a). Currently, the service has been provided to rural communities at the household level through the Health Extension Programme. Moreover, in the current road map for accelerating the reduction of maternal and newborn morbidity and mortality in Ethiopia (2011–2015), family planning is identified as one of the strategic objectives. The following targets are identified related to family planning: to increase contraceptive prevalence rate to 66%, decrease unmet needs for family planning to 10%, and reduce adolescent pregnancy rate to 5% (EMOH, 2011_b).

Though the overall contraceptive prevalence has been progressive with evidences of 2.6%, 8%, 14%, and 29% reported in 1990, 2000, 2005 and 2011 respectively (CSA, 2000 2005 and 2011 and Alkema et al.,2013).The practice of family planning differs significantly among regions, urban and rural areas

Various studies identified different demographic variables to influence women FP practice in Ethiopia. These variables among others include age, number of leaving children and lack to exposure risk of pregnancy (Bandura, 2010).

2.3. Family Planning Methods

Advances in medical technology over the last 35 years have made it possible for all women to plan their childbearing. There are various types of family planning methods based on the user‘s interest.

Traditional Methods of Family Planning

Traditional methods such as withdrawal and calendar-based methods have little upfront cost and are readily available, but are much less effective in typical use than most other methods.

Abstinence

The most effective method of contraception is complete abstinence from heterosexual intercourse. As a contraceptive technique, abstinence is ultimately 100 percent effective and offers additional protection against sexually transmitted infections. Although couples using this family planning technique may engage in other forms of sexual contact, most find it challenging to abstain from intercourse entirely (Juniper, 2014).

Withdrawal Method

Also known as coitus interrupts or "pulling out," the withdrawal method is one of the world's oldest family planning techniques. According to MayoClinic.com, withdrawal prevents conception by preventing sperm from entering the vagina. For withdrawal to work effectively, the man must fully withdraw his penis from his partner's vagina before he ejaculates. However, this method is not completely effective; sperm may leak if withdrawal is improperly timed. In some cases, viable sperm may also appear in pre-ejaculatory fluid, leading to an unplanned pregnancy (Juniper, 2014).

Rhythm Method

The rhythm method is also known as the calendar method; it works by predicting the days in which a woman is most fertile. To use this technique, a woman must chart her menstrual history for several months in order to anticipate the dates in which she is ovulating. According to MayoClinic.com, women using this technique must abstain from unprotected sex on the days

during which she is most fertile. The rhythm method can be somewhat effective, but it requires careful record-keeping and diligent adherence to the technique (Juniper, 2014).

Modern Family Planning Methods

Modern Family planning methods include oral contraceptives (the "Pill"); hormonal injectables; subdermal implants; intrauterine devices (IUDs); male and female sterilization; and barrier methods such as male and female condoms, diaphragms, and spermicides. Other modern methods include the Lactational Amenorrhea Method (LAM); fertility awareness methods such as methods that involve keeping track of when the fertile time of the menstrual cycle starts and ends (the Standard Days Method); and symptoms-based methods, which depend on observing signs of fertility like cervical secretions and basal body temperature (Johns, 2007).

Birth Control Pills

The birth control pill is a type of oral contraceptive that women must take every day. This method is best for women who can remember to take a pill every day and who want the advantage of restoring fertility quickly. According to the website Fertility Friend, 54 percent of women were fertile in their first cycles after discontinuing the pill, though it took up to nine months for full fertility to return. However, this method has risks and not all women can tolerate the hormones (WHO, 2014)

Barrier Methods

Barrier methods include male and female condoms, cervical caps and diaphragms. These methods prevent sperm from uniting with an egg. According to the website WomensHealth.gov, barrier methods must be in place before penetration, which can inhibit spontaneity. However, male condoms allow men to share responsibility for birth control and also prevent disease. Barrier methods have no side effects or long-term effects on fertility (WHO, 2014).

Long-Term Methods

When people do not want to worry about contraception on a regular basis, but may want the ability to conceive in the future, several long-term contraceptive methods can prevent pregnancy. Some of these methods include the contraceptive shot, vaginal ring, implantable rod and intrauterine device, also called an IUD. All of these methods are hormonal and are not easily reversible, but fertility returns after discontinuation (WHO, 2014)

These range of family planning methods, each with unique advantages and disadvantages. Long-acting reversible contraceptive methods, such as intrauterine device (IUD) and implant are highly effective and convenient, requiring little user action. When cost of failure is included, IUDs and vasectomy are much less costly than other methods. In addition to providing birth control, male or female condoms protect against sexually transmitted diseases (STD). Condoms may be used alone, or in addition to other methods, as backup or to prevent STD. Surgical methods (tubal ligation, vasectomy) provide long-term contraception for those who have completed their families.

While there is no ―ideal method" of family planning, there is a safe and effective method for every woman. Family planning methods vary according to their convenience, cost, effectiveness, side effects, risks, and benefits for the individual. Family planning users are best able to evaluate the relative importance of these factors based on their preferences; their desired family size; stage of life; goals of delaying, spacing, or limiting future pregnancies; health status; relationship status; and living conditions.(Johns, 2007)

2.4. Determinant of Family Panning Practice

The factors associated with family planning practice can be divided into socioeconomic, demographic and other proximate factors like behavioural and service factors. Among the personal factors associated with family planning practice are knowledge of family planning methods and influence of family members and friends, especially those who have experience in family planning methods. Demographic factors such as age, marital status, religion and number of living children are also known to be associated with family planning practice. Among the socio-economic factors that may affect Women's practice of family planning methods are place

of residence, work status/occupation, education level of women, wealth index and region are considered to be important (John et al., 2011).

Socio- Economic Factors

Residence

Residence is the one of Socioeconomic Factors that has effect on women‘s family planning practice. A study performed in Lucknow revealed that overall residential area had influence on use of family planning methods which correspondence with research made in India (NFHS-III, 2007) which showed that more urban than rural women used family planning methods. Moreover a research made in Southern Nations, Nationalities and Peoples Region in Ethiopia revealed that women residing in rural areas were significantly less likely to practice family planning compared to women in urban areas (Assefa and Fikrewold, 2011). The explanation for these urban rural differences no doubt includes the easier accessibility of family planning services in cities, the desire for more children in rural areas, and the greater education in urban areas to verify this a study conducted in northern Ethiopia (Kebede, 2006) found that urban women had more access to health services than rural women.

Level of Education

The level of education is another factor that significantly affects FP practice. It is believed that people with higher education are more likely to go for family planning services than their counterparts with lower education (Gaetano et al., 2014). A number of studies show that education of women is significantly associated with FP practice. For instance, in Kenya women with primary incomplete education were less likely to practice family planning compared to those with primary complete or higher education (Wafula and Ikamari, 2007). Similarly, further analysis made on EDHS 2000 revealed that educated women are significantly less likely to have an unmet need. As compared to women with no education, women who had primary education were about one third times more likely to practice FP, while women with at least a secondary level schooling were two thirds times likely to practice FP (Antenane, 2002).

Furthermore a study was done on Determinants of modern family planning use among women of reproductive age in the Nkwanta district of Ghana. Results of multilevel logistic regression in

this study showed that there is significant association between FP and education. The Study population ware all women aged 15–49 years living in Nkwanta district that had never practiced any modern family planning method. Thus the multilevel analysis revealed that Women with no formal education were significantly less likely to practice modern family planning relative to those with some formal education with the corresponding odds ratio(OR = 0.57, 95% C.I 0.37-0.87)(Sebastian et al., 2014).

Similarly a study conducted in Mojo city Ethiopia identified that Women who attained secondary and higher level of education were found to be 2 and 2.8 times more likely to have the intention to practice Family planning compared to women who had no education, respectively (Gizaw and Regassa, 2011). The study further explains this could be as a result of women that are empowered through education have better access to health facilities and information about modern contraceptive methods than uneducated women thus have higher probability of practicing FP.

Economic Status

Use of family planning methods is believed to increase sharply with wealth index of which is one of the factors that affect family planning practice. According to Mohanan et al., a significant influence of monthly income was found on acceptance of family planning methods .It is evident that more use of family planning methods was seen in women of higher wealth index (NFHS-III, 2007).

A study conducted by Westoff in 2012 revealed that use of family planning is higher for the highest wealth quintile as compared to the lowest wealth quintile indicating the presence of a direct relationship between income and use of family planning(Westoff, 2012).

Exposure to mass media

Exposure to mass media is an effective way towards contraceptive behaviour. By diffusing information, it will effect changes in attitudes and practice of contraception although this differs in a variety of populations. Family planning programs can use effective communication channels to address barriers affecting FP practice and to bring about a behavioural change. Effectively crafted, evidences-based messages can explain the true risk of unplanned pregnancy and address

concerns about contraceptive side effects and health risks (UNFPA, 2008). In most developing countries, especially in Sub-Saharan Africa, promoting family planning through radio and television is an important means of raising awareness, improving knowledge, and motivating use of modern contraceptive methods (ETR, 2007).

A study based on 2000 EDHS showed that women who had been exposed to the media were more likely to practice FP compared to women with no exposure (Antenane, 2002). Similarly another study performed in India found that women who have media exposure are significantly more likely to practice FP revealing that family planning is positively associated with exposure to family planning messages thus women exposed to media are more likely to practice FP (Laya , 2012).

Demographic factors

Various studies identified different demographic variables as influential in the practice of family planning methods in Ethiopia. These variables among others include age, number of living children and lack of exposure to the risk of pregnancy.

Age of Women

Among the demographic factors that affect the use of FP is Age. A research performed in Tanzania reveals Use of modern FP methods was highest among women in the age 35 years and above. This could be attributed to the fact that the younger ones, though highly sexually active, desire to bear children and are not yet ready to use contraceptives. Comparable observations have been made elsewhere (Anna and Nassoro, 2006), with a start up of acceptance of modern contraceptive methods being more in women of thirty years and above. However this finding doesn‘t imply that the age of the woman alone can predict the trend of use of FP methods among particular age groups.

Religion

Religion has been documented to be the most controversial factor influencing use of FP methods. Degree of one‘s adherence to the norms of a given religion may exert an influence on ones‟ mode of life including reproductive behaviour. Using data from the Butajira District in South Central Ethiopia, Wubegzier and Alemayehu (2012) reported that religion was one of the

determinants of family planning. In addition, a qualitative study in the Afar region of Ethiopia reported that women in the rural areas have some concerns about religious sayings and the implications that these sayings have about family planning use. Similarly a study conducted to assess Socio-economic and demographic determinants of unmet need for family planning in India and its consequences revealed that a significant association between religion and FP for both spacing and limiting (Barman, 2013).

Number of Living Children

The number of living children is also a factor influencing the practice of FP. Satisfying women's unmet need for family planning reduces the total fertility rate (TFR) by a considerable amount (Black, et al., 2010). An analysis of the 2005 Ethiopia Demographic Health Survey (EDHS) data for Southern Nations and Nationalities Peoples Region (SNNPR) revealed that women with higher number of living children (5 or more) were significantly more likely to have an unmet need for limiting births than women with less than five living children for both limiting and spacing births than women with no living children (Assefa and Fikrewold, 2011).

Furthermore a study performed in Kenya found that those women with more living children were more likely to practice FP. This suggests that contraception is adopted by high-parity women who wanted to cease childbearing (Ettarh, 2011).

Other proximate factors

Knowledge of FP methods

Lack of knowledge is an important cause for not practicing FP. At individual level, knowledge of FP methods is crucial. Whereas evidence from a number of studies around the world reveal a near universal knowledge on family planning among the women of the reproductive age group, this has not translated into increased utilization of these methods (Cleland et al., 2006 and Gizaw et al., 2011). This observation suggests that the women lack the right information that will aid decision making on use, an argument supported by evidence from related studies that showed increasing knowledge on the methods can result to higher utilization (Tang et al., 2009). Women therefore need to be empowered with adequate knowledge particularly on the health effects of modern FP methods to enable them make wise choices (Muiaet al., 1999).

Similarly the finding of a study by Paschal & Matthew in Ghana supported that although awareness of family planning was very high, this did not translate into high utilization of modern contraception. This is despite many respondents confirming receiving messages on FP from a variety of sources. The low usage of FP among the respondents could probably be because they do not have adequate information that would aid in choosing an appropriate contraceptive method. This also partially explains the fear of side effects (Paschal & Matthew, 2014).

2.5. Benefits of Family Planning for Women:

Family planning has several benefits, some of which are specific to the health of mothers and their children. Others include socioeconomic benefits; for example, women are able to advance their education and careers by delaying or limiting childbearing and this can bring better economic prospects to their household(Smith et al., 2009). Smith et al., (2009) and Bongaarts et al. (2012) pointed out the potential benefits of family planning, among other, as economic development, improvement in maternal and child health, educational advances and women‘s empowerment as well as to solve environment related problems like deforestation. In addition, increased contraceptive use can significantly reduce the costs of achieving selected Millennium Development Goals (MDGs) and directly contribute to reductions in maternal and child mortality.

A woman‘s ability to choose if and when to become pregnant has a direct impact on her health as well as her well-being. Family planning allows spacing of pregnancies and can delay pregnancies in young women at increased risk of health problems and death from early childbearing, and can prevent pregnancies among older women who also face increased risks. Family planning enables women who wish to limit the size of their families to do so. Evidence suggests that women who have more than four children are at increased risk of maternal mortality. By reducing rates of unintended pregnancies, family planning also reduces the need for unsafe abortion (WHO, 2013).

Family planning also enables birth spacing, ultimately reducing child mortality while enhancing the nutritional status of both mother and child. Consequently this could contribute to significantly empowering women, achieving universal education for all, and achieving long term environmental sustainability (Cleland et al., 2011). Several studies have assessed women‘s knowledge about, and use of contraceptives, in addition to barriers to the uptake of Family

planning services (Nangendo et al., 2012 and Tilahun et al., 2012) .A study conducted in Bondo District of Western Kenya found that few women knew that Family planning prevented conception, enabled child spacing, reduced the risk of acquiring and transmitting sexually transmitted infections and helped avoid high-risk pregnancies (Nangendo et al., 2012). Women with knowledge about contraceptives and the benefits of Family planning are more likely to use contraceptive. Knowledge enables women to make informed decisions about what contraceptives to use and when to use them (WHO, 2013).

Controlling family timing and size can also be a key to unlocking opportunities for economic success, education and equality. Indeed, many leaders of the civil rights and women‘s rights movements of the 1960s pointed to contraception as an important tool for social justice. They argued reliable contraception could help women complete their education and join the workplace as full partners with men. It could help women break cycles of poverty and government dependency across generations, patterns often perpetuated by unintended pregnancies, especially among teenagers. Thus Family planning represents an opportunity for women for enhanced education and participation in public life, including paid employment in non-family organizations (Adam et al., 2013).

CHAPTER THREE

3. Data and Methodology

3.1. Data Source

The dataset used in this study has been taken from the Ethiopia Demographic and Health Survey (EDHS) conducted by central Statistics Agency (CSA) in 2011. The 2011 EDHS is a nationally representative survey of women aged 15−49 from 17,817 households from 624 clusters throughout Ethiopia, 187 in urban areas and 437 in the rural areas. The survey utilized a multistage cluster sample based on the 1994 Population and Housing Census sample frame and was designed to obtain and provide information on the basic indicators of the health and demographic variables of interest for the following domains: Ethiopia as a whole, urban and rural areas of Ethiopia (each as a separate domain), and all geographic areas (nine regions namely: Tigray, Affar, Amhara, Oromiya, Somali, Benishangul-Gumuz, Southern Nations, Nationalities and Peoples (SNNP), Gambela and Harari regional states and two city administrations :Addis Ababa and Dire Dawa).

This multistage 2011 EDHS dataset is of hierarchical structure. The hierarchy for this study follows individuals/women as level-1, and regions as level-2. This means that individuals are nested in regions. From among the 17,817 households, 17,385 women were identified as eligible for the individual interview. Interviews were completed with 16,515 women, yielding a response rate of 95 percent. Thus, the analysis presented in this study on women family planning practice is based on 10176 women of reproductive age(this include all women in the reproductive age not specified to only married women).

3.2. Variables of the Study

3.2.1. The Response Variable

The response variables of this study is status of Women‘s family planning practice which is recoded as follows: those women who are currently practicing any of the three methods which are modern, traditional and folkloric methods are coded as 1 and those who do not practice any method are coded as 0.

The response variable for the i^{th} woman is represented by a random variable Yi with two possible values coded by 1 and 0. In view of this, the response variable of the ith Women Yi was measured as a dichotomous variable.

$$Y_i = \begin{Bmatrix} 1 \; if \; the \; i^{th} \; woman \; practice \; any \; FP method \\ 0 \; otherwise \end{Bmatrix}$$

3.2.2. Explanatory Variables/factors

Some of the major factors influencing women's family planning practice are listed below.Here woman's ability to refuse sex is not that common variable but it was considered since it is directly related to use of family planning not as empowerment index. That is, women were asked whether they could refuse sex or not.

No.	Factors/ variables	Categories
1	Age of a woman	1=15-24 2=25-39 3=Above 39
2	Place of Residence	1= Urban 2= Rural
3	Region	1=Tigray 2=Affar 3=Amahra 4=Oromiya 5=Somali 6=Ben-Gumuz 7= SNNP

		8=Harari 9=Gambela 10=Dire Dawa 11= Addis Ababa
4	Occupation of a woman	0=Not working 1=Agriculture Employee 2=Non-Agriculture Employee
5	Religion group of a woman	1=Orthodox 2=Protestant 3=catholic 4=Muslim 5=Others
6	Women‘s education level	0=No education 1=Primary 2=Secondary and higher
7	Exposure to any mass media	0=No 1= Yes
8	Knowledge on a FP method	0= Knows no FP method 1= Knows a FP method
9	Number of living Children	0= No children 1= small

		2= medium 3=large
10	Desire for more children	1=Yes 2=No 3-Undecided
11	Visited by FP worker during the last 12 Months	0= No 1= Yes
12	Economic status	1=Poor 2=Middle 3=Rich
13	Marital status	0=Never in a union 1=Married 2=Living together 3=No longer living together
14	Ability to refuse sex	0=No 1=yes 2=unsure

3.3. The Methodology

3.3.1. The Logistic Regression Analysis

Logistic regression is a popular modelling approach when the dependent variable is dichotomous or polytomous. This model allows one to predict the log odds of outcomes of a dependent variable from a set of variables that may be continuous, discrete, categorical, or a mix of any of these. Hosmer and Lemeshow (2000) have described logistic regression focusing on its theoretical and applied aspect.

Often the outcome variable in social data is, in general not continuous, instead is binary. In such a case, binary logistic regression is a useful way of describing the relationship between one or more independent variables and a binary outcome variable that has only two possible values. Indeed, a generalized linear model is used for binary logistic regression. The most attractive feature of a logistic regression model is that it neither assumes linearity in the relationship between the covariates and the outcome variable, nor does it require normally distributed variables. It also does not assume homoscedasticity and in general has less stringent requirements than linear regression models. Thus logistic regression is used in a wide range of applications leading to binary dependent data analysis (Hilbe, 2009; Agresti, 2002).

However, the assumptions that apply to logistic regression model include: meaningful coding, inclusion of all relevant and exclusion of all irrelevant variables in the regression model and low error in the explanatory variables. The binary logistic model is used to analyze factor that affects women‘s family planning practice.

Odds ratio: for a probability of success π, the odds of success are defined to be the ratio of probability of success π (in our case the probability of women practice FP $y = 1$) to probability of failure 1- π (in our case the probability of women don‘t practice FP

$y = 0$).

$$Odds = \frac{\pi}{1-\pi} \qquad (3.1)$$

The odds are non-negative with value greater than one when a success is more likely than a failure and between 0 and 1 when the appropriate is true. The odds ratio denoted as OR is defined as the ratio of the odds for $y = 1$ to the odds for $y = 0$ and is given by the equation:

$$OR = \frac{\pi(\quad)}{1-\pi(\quad)} * \frac{1-\pi(\quad)}{\pi(\quad)} \qquad (3.2)$$

The odds ratio is a measure of association which has found wide use, as it approximates how much more likely (or unlikely) it is for the outcome to be present among those with $y = 1$ than among those with $y = 0$.

3.3.1.1. Model

Let Y be an n×1 vector of response variable with $y_i = 1$ if the ith women under study practices any method and $y_i = 0$ if the ith women do not practices any method. Let X is, an n × (k+1) matrix denotes the collection of k-predictor variables and, β be a (k+1) ×1 vector of parameters and then the data layout of explanatory variables is given by:

$$X=\begin{bmatrix} 1 & x_{11} & x_{12} & \cdots & x_{1k} \\ 1 & x_{21} & x_{22} & \cdots & x_{2k} \\ \vdots & \vdots & \vdots & \cdots & \vdots \\ 1 & x_{n1} & x_{n2} & \cdots & x_{nk} \end{bmatrix}$$

The first (leading) column is a column of 1‘s. It corresponds to the constant or intercept of logistic regression equation. X without the leading column of 1s, is termed as predictor data matrix. Then, the conditional probability of Y given X is given by:

$$\pi = p(\quad = 1/X) = \frac{\exp(\beta_0 + \beta_1 x_1 + \ldots \beta_k x_k)}{1+\exp(\beta_0 + \beta_1 x_1 + \ldots \beta_k x_k)} = \frac{\exp(X'\beta)}{1+\exp(X'\beta)} \qquad (3.3)$$

Using (3.3), we obtain the odds of success as

$$odds(Y=1) = \frac{\pi}{1-\pi} = \exp(X'\beta) \qquad (3.4)$$

In logistic regression analysis, it is assumed that the explanatory variables affect the response through a suitable transformation of the probability of the success. This transformation is a suitable link function of π, and is called the logit-link, which is defined as: $\log(e^{X'\beta})$

$$\log it(\pi) = \log\left(\frac{\pi}{1-\pi}\right) = \log\left(\beta_0+\beta_1\chi_1+\ldots\beta_k\chi_k\right) = \log\left(e^{X'\beta}\right) \qquad (3.5)$$

The transformed variable, denoted by logit (π) is the log-odds and is related to the explanatory variables as:

$$\log it(\pi) = \eta(x) = \beta_0 + \beta_1 X_1 + \ldots + \beta_k X_k = X'\beta$$

The above equations give suitable representations of the success probability, odds, and log-odds. Indeed, these representations facilitate interpretations of parameter estimates. The parameter β_i refers to the effect of X_i on the log odds that Y = 1, controlling the other X's in the model. For predictor variables having L levels ($L \geq 2$) interpretation can be made by making one of the L-levels as a reference category.

3.3.1.2. Parameter Estimation

The logistic regression model just described is a generalized linear model with binomial errors and logit link. Instead of finding the best fitting line by minimizing the sum of the squared residuals, as we did with OLS regression, we use Maximum Likelihood (ML) estimation to obtain estimates of the coefficients in the logit equation given in (3.5).

ML methods seek to maximize the log likelihood, LL, which reflects how likely it is that the observed values of the outcome may be predicted from the observed values of the predictors. ML method for this case is based on Newton- Raphson iteratively reweighted least square algorithm until it gets the smallest possible deviance or best fit.

Specifically, for a sample of size n whose observations are $(y_1, y_2, \ldots, y_n)$ the corresponding random variables are $(Y_1, Y_2, \ldots, Y_n)$ Since the Y_i is a Bernoulli random variable, the probability mass function of y_i is:

$$f_i(y_i) = \pi_i^{y_i}(1-\pi_i)^{1-y_i} \qquad (3.6)$$

$$y_i = 0 \text{ or } 1 \text{ and } i = 1,2,\ldots,n$$

Since the observations are assumed to be independent, the likelihood function is obtained as the product of the terms given in expression (3.6) as follows:

$$L(\beta) = \prod_{i=1}^{n} \pi_i^{y_i}(1-\pi_i)^{1-y_i}$$

The maximum likelihood estimate is the parameter value of β that maximizes the likelihood function. However, it is easier mathematically to work with the log likelihood function. The log likelihood is:

$$l(\beta) = \ln[L(B)] = \sum_{i=1}^{n} y_i \ln\left(\frac{\pi_i}{1-\pi_i}\right) + \sum_{i=1}^{n} \ln(1-\pi_i) \qquad (3.7)$$

To find the value of β that maximizes $l(\beta)$ we differentiate $l(\beta)$ with respect to β and set the resulting expressions equal to zero. These equations, known as the likelihood equations, are:

$$\sum_{i=1}^{n} [y_i - \pi_i] = 0$$

$$\text{and} \quad \sum_{i=1}^{n} x_i[y_i - \pi_i] = 0 \qquad (3.8)$$

For logistic regression the expressions in equation (3.8) are nonlinear in β and thus require special methods for their solution. These methods are iterative in nature and have been programmed into available logistic regression software. As such, it represents the fitted or predicted value for the logistic regression model. An interesting consequence of equation (3.8) is that

$$\sum y_i = \sum \hat{\pi}_i$$

That is, the sum of the observed values of y is equal to the sum of the predicted (expected) values.

In fact, the maximum likelihood estimates of β in the multiple binary logistic regression models are those values of β that maximize the log-likelihood function given in equation (3.6). No closed form solution exists for the values of $\hat{\beta}$ that maximize the log-likelihood function. Computer-intensive numerical search procedures are therefore required to find the maximum likelihood estimates $\hat{\beta}$ and hence $\hat{\pi}$, because the multiple logistic regression model computes the probability of the selected response as a function of the values of the predictor variables. There are several widely used numerical search procedures, one of these employs iteratively reweighted least squares algorithm. In this study, we shall rely on standard statistical software programs to obtain the maximum likelihood estimates of parameters.

3.3.1.3. Goodness of Fit of the Model

Once a model has been developed, we would like to know how effective the model is in describing the outcome variable. This is referred to as goodness-of-fit.

Goodness of fit of the model can be assessed in two ways first by testing the overall goodness of the model and second by testing the significance of each explanatory variable in the model.

Hosmer–Lemeshow Test

The Hosmer–Lemeshow test is a commonly used test for assessing the goodness of fit of the model and allows for any number of explanatory variables, which may be continuous or categorical. The Hosmer–Lemeshow test uses a test statistic that asymptotically follows a χ^2

distribution to assess whether or not the observed event rates match expected event rates in subgroups of the model population. The test hypothesis is given by:

H_0: The model fits the data. Vs.

H_1: The model does not fit the data.

The test statistic is constructed by grouping the data set into groups (often g=10). The groups are formed by ordering the existing data by the level of their predicted probabilities. So the data are first ordered from least likely to have the event to most likely for the event. Then g roughly equal sized groups are formed. The observed and expected numbers of events are computed for each group. The test statistic is:

$$\hat{C} = \sum_{K=1}^{g} \frac{(O_k - E_k)^2}{v_k} \qquad (3.9)$$

Where, O_k and E_k are the observed and expected number of events in the k^{th} group, and v_k is a variance correction factor for the k^{th} group. If the observed number of events differs from what is expected by the model, the statistic $\hat{C}$ will be large and there will be evidence against the null hypothesis. This statistic has an approximate chi-squared distribution with (g – 2) degrees of freedom. The advantage of a summary goodness-of-fit statistic like is that it provides a single, easily interpretable value that can be used to assess fit (Hosmer and Lemeshow, 2000).

Likelihood ratio test

We use likelihood ratio test for checking the significance of the overall model and the significance of individual parameters in the model. Likelihood ratio test is based on comparing the log-likelihood value of two different models; one with k explanatory variables sometimes called saturated model and the other with j (j<k) explanatory variables. In most cases the comparison is made between the log likelihood of the saturated model and the log likelihood of intercept only (in the absence of explanatory variables) model. If this difference is statistically significant, then the less restrictive model (the one with more variables) is said to fit the data significantly better than the more restrictive model. The likelihood ratio test statistic is given as follows:

$$G^2 = [(-2\ln L_0) - (-2\ln L_1)]$$

Where, L_0 is the likelihood of the null model or constant only model and L_1 is the likelihood of the saturated model or the model containing k predictors.Under the global null hypothesis , $H_0 = \beta_1 = \beta_2 = ... = \beta_k = 0$, the statistic G^2 follows a chi square distribution with k-1 degrees of freedom and measures how well the independent variables affect the response variable (Hosmer and Lemeshow, 2000).

3.3.1.4. Statistical Tests of Individual Predictors

The statistical significance of individual regression coefficients is tested using the Wald and Score chi-square statistic. The Wald statistic is a test which is commonly used to test the significance of the individual logistic regression coefficients for each independent variable (that is, to test the null hypothesis in logistic regression that a particular logit coefficient is zero i.e. H_o:β_i=0 against $\beta_i \neq 0$, i=1.....k.

The Wald test is based on the behaviour of the log-likelihood function at the ML estimate$\hat{\beta}$, having chi-squared form. The standard error of the estimate depends on the curvature of the log-likelihood function at the point where it is maximized, with greater curvature giving smaller SE values. For a dichotomous dependent variable, the Wald statistic is:

$$W = \left[\frac{\hat{\beta}}{SE(\hat{\beta})}\right]^2 \qquad (3.10)$$

Under the null hypothesis for large sample size, this statistic has an approximate chi- square distribution with one degree of freedom.

3.3.1.5. Model Diagnostic

Before concluding that the model "fits", it is crucial that other measures be examined to see if fit is supported over the entire set of covariate patterns. This is accomplished through a series of specialized measures falling under the general heading of regression diagnostics.

Model diagnostic procedures involve both graphical methods and formal statistical tests. These procedures allow us to explore whether the assumptions of the regression model are valid and decide whether we can trust subsequent inference results.

I. **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. The influential observations for the individual regression coefficients are identified by $DFBETAS_{j(i)}\ j = 0,1,2,\ldots p$, where each $DFBETAS_{j(i)}$ 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 $(X'X)^{-1}$. $DFBETAS_{j(i)}$ change in $\hat{\beta}_j$ in multiples of its standard error.

II. **Leverage (hat matrix)**: an observation with an extreme value on the predictor variable is called a point with high leverage. Leverage is a measure of how far an observation deviates from the mean of that variable. These leverage points can have an effect on the estimate of regression coefficients. It can be calculated by:

$$h_i = \frac{1}{n} + \frac{(x_i - \bar{x})^2}{S_{XX}}$$

where h_i =Leverage value, n= Number of observations and Sxx is Standard error

III. **Cook's distance (D)**: measures 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 (Cook and Weisberg, 1982).The formula is

$$D_i = \frac{r_i^2 Var(\hat{y}_i)}{pVar(\varepsilon_i)} = \frac{r_i^2 h_{ii}}{p(1-h_{ii})}$$

where:- D_i = Cook's distance, r_i^2 = Standardized residual, h_{ii} = Leverage and

P= Number of predictors

3.3.2. Multilevel Logistic Regression Model

Multilevel models have been developed to allow analysis at several levels simultaneously (hence the name multilevel), rather than having to choose at which level to carry out a single level analysis. Multilevel models can be fitted for dependent variables that are interval, scale or with categorical outcomes as well as allowing the relationship between the explanatory and dependent variables to be estimated, having taken into account the population structure. Multilevel models enable the extent of variation in the outcome of interest (in this case FP) to be measured at each level assumed in the model -both before and after the inclusion of explanatory variables in the model.

In the case of this study the individuals are nested in regions so two-level logistic regression model is a good way to go. The Women are level-1 and the regions are level-2. For the purpose of simplicity, let us consider a two-level model for binary outcome with a single explanatory variable.

A multilevel logistic regression model also referred to in the literature as a hierarchical model, can account for lack of independence across levels of nested data. Standards logistic regression assumes that all experimental units (in this case, women) are independent in the sense that any variables affecting the dependent variable have the same effect in all regions. Multilevel modelling relaxes this assumption and allows these variables‟ effects to vary across regions.
Hierarchical models are statistical models that can be used to analyze nested sources of variability in hierarchical data, taking account of the variability associated with each level of the hierarchy. These models have also been referred to as multilevel models, mixed models, random coefficient models, and covariance component models (Breslow and Clayton, 1993; Longford, 1993; Snijders and Bosker, 1999; Hox, 2002; Goldstein, 2003).

3.3.2.1. Two level model

For simplicity of presentation two-level models are used for this study, i.e., models accounting for women-level and regional-level effects. In this data structure, level-1 is the women level and level-2 is the regional level. Within each level-2 unit there are n_j woman in the j^{th} region. We further simplify the presentation by assuming there is women-level predictor and regional-level factor.

To provide a familiar starting point, we first consider a two-level model for binary outcomes with a single explanatory variable. Conceptually, the basic multilevel model for a binary response is equivalent to model (3.4) except for the notation in the outcome variable. Suppose we have data consisting of women (level one) grouped into regions (level two). Let Y_{ij} be the binary response for women i in region j and X_{ij}, an explanatory variable at the women level. We define the probability of the response equal to one as $P_{ij} = Pr\ (y_{ij} = 1)$ and let P_{ij} be modeled using a logit link function. The standard assumption is that y_{ij} has a Bernoulli distribution. Then the two-level model can be written as

$$\log\left[\frac{P_{ij}}{1-P_{ij}}\right] = \beta_0 + \beta_1 X_{ij} + U_j \qquad (3.11)$$

Where $U_j \sim IID(0, \sigma_u^2)$. U_j is the random effect at level two. Without U_j, Equation (3.11) would be a standard logistic regression model. Conditional on U_j, the y_{ij} is assumed to be independent. The model (3.11) is often described as follows.

$$\text{logit}(P_{ij}) = \log\left[\frac{P_{ij}}{1-P_{ij}}\right] = \beta_{0j} + \beta_i X_{ij} \qquad \text{[Level 1 model]}$$

and, $\beta_{oj} = \beta_0 + U_j$ [level 2 model]

3.3.2.2. Testing Heterogeneity of Proportions

For the proper application of multilevel analysis in general and multilevel logistic regression analysis in particular, the first logical step is to test for heterogeneity of proportions between groups (in our case between Regions). Two commonly used test statistics that are used to check for heterogeneity of proportions are described below.

To test whether there are indeed systematic differences between groups, the well-known chi-square test for contingency tables can be used. The test statistic of the chi-squared test for a contingency table is often given in the familiar form:

$$X^2 = \sum_i \frac{(O-E)^2}{E} \qquad (3.12)$$

Where O is the observed and E is the expected counts in the cell of contingency Table.

It can also be written as:

$$\chi^2 = \sum_{j-1}^{N} n_j \frac{(\hat{p}_{.j} - \hat{p}_{.})^2}{\hat{p}_{.}(1-\hat{p}_{.})} \qquad (3.13)$$

$$\hat{p}_{.j} = \frac{1}{n_j}\sum_{i=1}^{n_j} y_{ij} \quad \text{and} \qquad \hat{p}_{.} = \frac{1}{M}\sum_{j=1}^{N}\sum_{i=1}^{n_j} Y_{ij} \qquad M = \sum_{j=1}^{N} n_j$$

Where N is the number of groups, n_j is the number of samples in the j^{th} group.

This statistic follows approximately a chi-square distribution with N-1 degrees of freedom. This chi-squared distribution is an approximation valid if the expected number of success ($n_j \hat{p}_j$) and of failures ($n_j (1- \hat{p}_j)$) in each group are at least 1 while 80 percent of them are at least 5 (Agresti, 2007). This condition will not always be satisfied, and the chi-square test then may be seriously in error. For a large number of groups the null distribution of the test statistic of the chi-square can be approximated by a normal distribution with the correct mean and variance (McCullagh and Nelder, 1989).

The second test of heterogeneity of proportions was proposed by Commenges and Jacqmin (1994). The test statistic is:

$$Z = \frac{\sum_{j=1}^{N} n_j (\hat{p}_j - \hat{p}_.)^2}{\hat{p}_.(1-\hat{p}_.)\sqrt{2\sum_{j=1}^{N} n_j (n_j - 1)}} \qquad (3.14)$$

The statistic, Z, follows the standard normal distribution for large values of M. Thus, large calculated value of this statistic is indication of heterogeneous proportions. In equation (3.15) the numerator contains a weight of n_j^2 whereas the chi-square test uses a weight n_j. This shows that the two tests combine the groups in different ways. Hence, when the group sizes n_j are different, it is possible that the two tests may lead to different outcomes. The test statistic Z is shown to have high power over the chi-square test and can be applied whenever there are many groups, even with small group sizes, provided that no single group dominates (Snijders and Bosker, 1999).

Estimations of Between and Within Group Variance

The theoretical variance between the group dependent probabilities, i.e. the population values of Var (p_j) can be estimated by:

$$\hat{\tau}^2 = S^2_{between} - \frac{S^2_{within}}{\tilde{n}} \qquad (3.15)$$

Where $$\tilde{n} = \frac{1}{N-1}\left(M - \frac{\sum_{j=1}^{N} n_j^2}{M}\right)$$

For dichotomous outcome variables, the observed between group variance is closely related to the chi-square test statistic.

$$S^2_{between} = \frac{\hat{p}(1-\hat{p})}{\tilde{n}(N-1)}\chi^2 \qquad (3.16)$$

Where χ^2 is as given by equation (3.12)

The within group variance in case of a dichotomous outcome variable is a function of group averages which is given by:

$$S^2_{within} = \frac{1}{M-N}\sum n_j p_j (-p_j) \qquad (3.17)$$

3.3.2.3. The Empty Multilevel Logistic Regression Model

The empty two-level model for a dichotomous outcome variable refers to a population of groups (level-two units) and specifies the probability distribution for group-dependent probabilities p_j in $Y_{ij} = p_j + \varepsilon_{ij}$ without taking any explanatory variables into account. We focus on the model that specifies the transformed probabilities $f(p_j)$ to have a normal distribution.

This is expressed, for a general link function f (p), by the formula $f(p_j) = \beta_0 + U_{0j}$, where β_0 is the population average of the transformed probabilities and U_{0j} is the random deviation from this average for group j. If f (p) is the logit function, then $f(p_j)$ is just the log-odds for group j. Thus, for the logit link function, the log-odds have a normal distribution in the population of groups, which is expressed by:

$$\text{Logit}(p_j) = \beta_0 + U_{0j} \qquad (3.18)$$

For the deviations U_{0j} are assumed to be independent random variables with a normal distribution with mean zero and variance δ_0^2 $[U_{0j}]$. This model does not include a separate parameter for the level-one variance (Snijders and Bosker, 1999).

For the logit function, the so-called logistic transformation of β_0, is defined by

$$\pi_0 = \text{logistic}(\beta_0) = \frac{\exp(\beta_0)}{1+\exp(\beta_0)} \qquad (3.19)$$

Due to the non-linear nature of the logit link function, there is no simple relation between the variance of probabilities and the variance of the deviations U_{0j} (Snijders and Bosker, 1999). An approximate variance of the probability given by:

$$\text{Var}(p_j) \approx \tau_0 (-\pi_0)^2 \delta_0^2 \quad (3.20)$$

Note that an estimate of population variance Var (p_j) can be obtained by replacing sample estimates of π_o and σ_0^2. The resulting approximation can be compared with the nonparametric estimate, $\hat{\tau}^2$ which was given in the above equation (3.15).

3.3.2.4. The Random Intercept Multilevel Logistic Regression Model

In the random intercept logistic regression model, the intercept is the only random effect meaning that the groups differ with respect to the average value of the response variable. It represents the heterogeneity between groups in the overall response.

The logistic random intercept model expresses the log-odds, i.e. the logit of P_{ij}, as a sum of a linear function of the explanatory variables and a random group-dependent deviation U_{0j}. That is,

$$logit(P_{ij}) = log\left(\frac{P_{ij}}{1-P_{ij}}\right) = \beta_{oj} + \beta_1 X_{1ij} + \beta_2 X_{2ij} + \cdots + \beta_k X_{kij}$$

$$logit(P_{ij}) = \beta_{oj} + \sum_{h=1}^{k} \beta_h X_{hij} \quad (3.21)$$

where:- the intercept term β_{oj} is assumed to vary randomly and is given by the sum of an average intercept β_o and group- dependent deviations U_{0j}. That is:

$$\beta_{oj} = \beta_o + U_{oj}$$

As a result

$$logit(P_{ij}) = \beta_o + \sum_{h=1}^{k} \beta_h X_{hij} + U_{oj} \quad (3.22)$$

$$U_{oj} \sim IID(0, \sigma_0^2)$$

Where β_o is the log-odds that y = 1 when x = 0 and u = 0, is the effect on log-odds of dependent variable in same group (same value of u), exp (β_h) is an odds ratio, comparing odds for individuals in the same group. U_{0j} is the effect of being in group j on the log-odds that y = 1 also known as a level 2 residual, σ_0^2 is the level 2 (residual) variance, or the between-group variance in the log-odds that y = 1 after accounting for x.

Note that the first part of the left-hand side of equation (3.22), incorporating the regression coefficients, $\beta_o + \sum_{h=1}^{k} \beta_h X_{hij}$ is the fixed part of the model, because the coefficients are fixed. The remaining part U_{oj} is called the random part of the model.

3.3.2.5. The Random Coefficient Multilevel Logistic Regression Model

So far, we have allowed the probability of FP to vary across regions, but we have assumed that the effects of the explanatory variables are the same for each region. We will now modify this assumption by allowing the difference between explanatory variables within a region to vary across regions. To allow for this effect, we will need to introduce a random coefficient for those explanatory variables. So, a random coefficient model represents heterogeneity in relationship between the response and explanatory variables.

As mentioned above, the response variable in this study, the status of women‘s family practice was binary. Therefore the statistical model used in this analysis was the two-level random coefficient multilevel regression model. The model, with p level-1 predictors and q level- 2 predictors, can be expressed as:

$$logit(\pi_{ij}) = \log\left[\frac{\pi_{ij}}{1-\pi_{ij}}\right] = \beta_{oj} + \sum_{h=1}^{p} \beta_{hj} X_{hij} + \sum_{h=1}^{q} U_{hj} X_{hj} \qquad (3.23)$$

Where:-

$\beta_{oj} = \beta_o + U_{oj}$, i=1,2,3...,$n_j$, j=1,2,3,...,11

Now the above equation is written as

$$\text{logit}(\pi_{ij}) = \log\left[\frac{\pi_{ij}}{1-\pi_{ij}}\right] = \beta_0 + \sum_{h=1}^{p} \beta_h X_{hij} + U_{oj} + \sum_{h=1}^{q} U_{hj} X_{hj} \qquad (3.24)$$

$$Y_{ij} \sim \text{Binary}(\pi_{ij}), U_{oj} \sim \text{Normal}(0, \sigma_0^2)$$

The first part of equation (3.18), $\beta_0 + \sum_{h=1}^{p} \beta_h X_{hij}$ is called the fixed part of the model. The second part $U_{oj} + \sum_{h=1}^{q} U_{hj} X_{hj}$ is called the random part.

Y_{ij} is the value of the response variable for the i^{th} woman in the j^{th} region. X_{hij} is the value of individual-level explanatory variable X_p for the i^{th} woman in the j^{th} region. X_{hij} is the value of region-level explanatory variable X_q for the j^{th} region. U_{0j} is the region-level residual of the j^{th} region. It is a random effect that represents the discrepancy between β_0 and the true intercept of the j^{th} region and n_j is the number of women respondents in the j^{th} region.

3.3.2.6. Intra-class Correlation Coefficient (ICC)

The fundamental reason of using multilevel analysis is the existence of more similarities between Women in the same Region than in different Regions. This leads to the existence of intra-class (intra-Regional) correlation of Women's family planning practice. ICC is the degree of resemblance between level one units belonging to the same group. It is an indication of the proportion of variance at the second level (region) and it can also be interpreted as the expected (population) correlation between two randomly chosen individuals within the same group (Joop ,2010).

In two- level model, the ICC is calculated in the intercept only model. This model can be derived from "Eq. (3.23)" by excluding all explanatory variables, which results in the following equation: $\text{logit}(p_j) = \beta_o + U_{oj}$ .The ICC is then calculated based on the following formula:

$$ICC = \frac{\sigma_{\hat{u}o}^2}{\sigma_{\hat{u}o}^2 + \sigma_{\hat{e}}^2} \qquad (3.25)$$

Where, $\sigma_{\hat{e}}^2$ is variance of individual (lower) level units.

Since the logistic distribution for the level one residual variance implies a variance of $\frac{\pi^2}{3} \approx 3.29$ (Snijders and Bosker, 1999) and this formula can be reformulated as:

$$ICC = \frac{\sigma_{\hat{u}o}^2}{\sigma_{\hat{u}o}^2 + 3.29} \qquad (3.26)$$

3.3.2.7. Parameter Estimation

The estimation procedures of most of the statistical models (example, linear regression, logit models and log-linear models) routinely used are well established. But this is not true for multilevel models for binary data. Marginal quasi-likelihood or MQL (Goldstein,1991; Goldstein and Rasbash 1996) and penalized quasi-likelihood or PQL (Breslow and Clayton, 1993) are the two prevailing approximation estimation procedures. Both MQL and PQL are based on Taylor series expansion to achieve the approximation. After applying these quasi likelihood methods, the model is then estimated using iterative generalized least squares (IGLS) or reweighted IGLS (RIGLS)(Goldstein, 2003).

Besides, there are other estimation methods: Maximum Likelihood Method (several simulation based; McCulloch (1997)), Bayesian methods using Markov Chain Monte Carlo (MCMC), adaptive Gaussian quadrature (AGQ) and the Iterative Bootstrap method. Using MCMC simulation technique has come to the forefront of statistical research over the last one and half decade (Gelfand et al., 1990) and also it is being used with greater extent in multilevel modeling recently.

3.3.2.8. Significance testing

As with ordinary least squares regression or logistic regression, we can consider significance tests for individual estimates, such as intercepts, slopes, and their variances, as well as whether the full model accounts for a significant amount of variance in the dependent variable. In between, there is also the possibility of determining whether the subset of predictors contribute significantly.

3.3.2.8.1. Significance Testing for Fixed Effects

The fixed effects in multilevel regression are typically tested in a familiar way, by creating a ratio of the intercept or slope estimate to the estimate of the standard error (Newsom, 2011). The usual null hypothesis test is whether the coefficient, either intercept or slope, is significantly different from zero (i.e., is the population value zero or not). This kind of ratio, usually distributed as a z or t, is used in many statistical tests (Bryk and Raudenbush, 1992).

$$t = \frac{\hat{\beta}_h}{S.E(\hat{\beta}_h)}$$

Where $\hat{\beta}_h$ is either the intercept or slope coefficient and S.E. ($\hat{\beta}_h$) is the standard error estimate.

In SPSS, STATA and MLwin fixed effects tests involve the same ratio of the estimate to the standard error estimate, but significance is determined by the normal curve, so it is considered a z-test. The z-test is often referred to as a ―Wald" test.

3.3.2.8.2. Significance Testing for Random Effects

Random effects tests examine hypotheses about whether the variance of intercept or slopes (or their covariance) is significantly different from zero. The tests of variances and covariances are made using a Wald z-test and chi-square test. The Wald test for variances is simply a ratio of the variance estimate divided by the standard error estimate. Significance tests of variances (but not covariance) using this approach should be interpreted after dividing the p-Value from the output in half (i.e., as a one-tailed test;Snijders & Bosker, 1999).

3.3.2.9. Goodness of Fit Test

Likelihood Ratio Tests for Multiple Parameters

Another approach to significance tests involves a comparison of two ―nested models." Nested model tests involve comparison of one model to another model that specifies only a subset of the parameters included in the first model (provided the same set of cases are used in both models).

The likelihood ratio test compares the deviance (-2 log likelihood) of two models by subtracting the smaller deviance (model with more parameters) from the larger deviance (model with larger deviance). The difference is a chi-square test with the number of degrees of freedom equal to the number of different parameters in the two models. Any number of parameters can be compared in the two models. In the case where the empty model is compared to a full model, the likelihood ratio test provides information about whether the predictors in the model together account for a significant amount of variance in the dependent variable.

AIC and BIC

The AIC (Akaike Information Criterion) and the BIC (Bayesian Information Criterion) are two popular measures for comparing maximum likelihood models. AIC and BIC are defined as:

AIC= -2*ln (Likelihood) + 2*K

BIC= -2*ln (Likelihood) + ln (N)*K

Where k is the model degrees of freedom calculated as the rank of variance–covariance matrix of the parameters and N is the number of observations used in estimation or, more precisely, the number of independent terms in the likelihood. AIC and BIC can be viewed as measures that combine fit and complexity. Fit is measured negatively by -2*ln (Likelihood). The larger the value, the worse the fit is. Complexity is measured positively, either by 2*k(AIC) or ln (N)*k(BIC). The larger the value also, the worse the fit is. Given two models fit on the same data, the model with the smaller value of the information criterion is considered to be better (Akaike, 1974).

3.3.2.10. Model Diagnostic

It is of interest to obtain the residual values from the estimated multilevel model. Plots are a good way to examine the residuals. But in multilevel logistic regression, many different residual plots can be used. For this study, the fitted model was checked for possible presence of outliers and influential values in a similar fashion with standard logistic model. But additionally, the presence of outliers and influential observation were examined for level two. Leverage and influence value greater than one is considered as an influential observation for both level one and level two.

CHAPTER FOUR

4. STATISTICAL DATA ANALYSIS AND RESULTS

The objective of this chapter is to provide analysis of results on socioeconomic, demographic and other proximate determinant of women's family planning practice. The analysis was done using SPSS version 17 and STATA version 11.

4.1. Results of descriptive analysis

The major socio-economic, demographic and other proximate determinants of the respondents (women) are presented in Table 4.1. Out of the 10176 women of reproductive age, 84.7 percent did not practice FP while 15.3 percent of these women practice FP at the time of the survey.

TABLE 4. 1 RESULTS OF DESCRIPTIVE ANALYSIS OF SOCIO-ECONOMIC AND DEMOGRAPHIC FACTORS.

		Practice any FP method				
Variables	**Categories**	**Not practicing**	**Percent**	**Practicing method**	**Percent**	**Total**
Age of women	15-24	3692	88.7%	472	11.3%	4164
	25-39	3729	79.4%	967	20.6%	4696
	Above 39	1201	91.3%	115	8.7%	1316
Region						
	Tigray	462	89.9%	52	10.1%	514
	Affar	1156	96.0%	48	4.0%	1204
	Amhara	320	72.4%	122	27.6%	442
	Oromiya	1319	83.7%	257	16.3%	1576
	Somali	849	97.7%	20	2.3%	869
	Ben-Gumuz	747	84.6%	136	15.4%	883
	SNNP	1370	83.8%	264	16.2%	1634

	Gambela	703	84.2%	132	15.8%	835
	Harari	703	80.4%	171	19.6%	874
	Addis Ababa	196	48.5%	208	51.5%	404
	Dire Dawa	797	84.7%	144	15.3%	941
Place of resident						
	Urban	717	24.1%	2260	75.9%	2977
	Rural	6362	88.4%	837	11.6%	7199
Religion						
	Orthodox	5379	88.3%	711	11.7%	6090
	Catholic	2385	82.5%	507	17.5%	2892
	Protestant	645	66.7%	322	33.3%	967
	Muslim	213	93.8%	14	6.2%	227
Economic status						
	Poor	3762	92.7%	295	7.3%	4057
	Middle	1133	86.3%	180	13.7%	1313
	Rich	3727	77.5%	1079	22.5%	4806
Number of living children						
	No child	3202	94.6%	182	5.4%	3384
	Small	1187	87.7%	167	12.3%	1354
	Medium	1458	83.5%	289	16.5%	1747
	Large	2775	75.2%	918	24.8%	3691
Knowledge about FP method						
	Knows no method	2455	82.7%	515	17.3%	2970
	Knows method	6167	85.6%	1039	14.4%	7206
Visited by family planning worker last 12 months						

	No	7514	86.4%	1182	13.6%	8696
	Yes	1108	82.7%	372	25.1%	1480
Highest educational level of women						
	No education	4753	88.8%	597	11.2%	5350
	Primary	2874	82.3%	618	17.7%	3492
	Secondary and+	995	74.6%	339	25.4%	1334
Exposure to mass media						
	No	5621	90.1%	615	9.9%	6236
	Yes	3001	76.2%	939	23.8%	3940
Desire for more children						
	Yes	5944	84.0%	1133	16.0%	7077
	No	388	14.0%	2387	86.0%	2775
	Undecided	291	89.8%	33	10.2%	324
Women's occupation						
	Not working	4922	88.7%	629	11.3%	5551
	Agricultural employee	1497	80.3%	367	19.7%	1864
	Non Agricultural employee	2203	79.8%	558	20.2%	2761
Current marital status						
	Never in union	299	63.3%	173	36.7%	472
	Married	2484	97.3%	68	2.7%	2552
	Living with partner	901	91.9%	79	8.1%	980
	No longer living together	4938	80.0%	1234	20.0%	6172

Ability to refuse sex		3793	82.4%	809	17.6%	4602
	No					
	Yes	4667	86.6%	720	13.4%	5387
	Not sure	162	86.6%	25	13.4%	187

The highest percentage (20.6%) of practicing FP for women was observed in the age group 25-39 followed by the age group 15-24(11.3%) and the lowest percentage (8.7%) of practicing FP was observed in the age group Above 39.

The proportion of FP practice among women differed by place of residence. Among the women who resided in urban areas, 75.9 percent practiced FP. Among rural women, 11.6 percent practiced FP and 88.4 percent did not practice FP. Thus the practice of FP was much higher among women who were residing in urban areas as compared to Women‘s in rural area.

Moreover, women who lived in different regions had different status of FP practice. The highest proportion (51.5percent) of women who practice FP was observed in Addis Ababa followed by Amhara (27.6 percent) and the least proportion (2.3%) of women‘s who practice FP was observed in Somali region, followed by Affar region (4.0%). There appeared to be some region wise variation in the proportion of women‘s FP practice.

The percentage of women who practices FP methods was higher among those women who were followers of Protestant (33.3%) followed by catholic (17.5 %). The lowest percentage (6.2%) of FP practice was observed among women who were followers of Muslim Religion.Out of those women who have knowledge of family planning methods, 14.4 percent practices FP and the remaining 85.6 percent didn‘t practice FP.

The status of practicing a FP among Women from poor households was 7.3%, 13.7% for women in medium household and 22.5% for rich women.

With regard to the number of living children, the highest percentage (24.8 percent)of FP practice were those women who had large number of children followed by those women who had medium number of living children (16.5percent).Moreover, the least proportion (5.4 %)of women‘s FP practice were women who had no children.

It is believed that exposure to any kind of family planning methods through the mass media like radio, TV and newspapers and magazines enhance practice of family planning. Women who were exposed to any kind of mass media, 23.8 percent practiced FP and 76.2 percent did not practiced FP.

Out Of those women who were not exposed to any mass media, only 9.9 percent practiced FP. The highest percentage (36.7%) of family planning practice was observed in individuals who were never in union. Out of the women who were married 2.7% of them practices family planning.

The proportion of women who practiced family planning methods was 25.1 percent among the women who had been visited by a family planning worker during the last 12 months before the survey and 13.6 percent among those who had not been visited during the last 12 months before the survey. Out Of the women who had desire for more children, 16.0 percent practiced family planning while 84.4% of those women who had no desire for more children practiced family planning.

Results of descriptive statistics in Table 4.1 also showed that 20.2 % of women who were non agriculture employee practiced family planning while, 11.3% of women who were not working practiced family planning.

The table also shows that the proportion of women practicing family planning was 25.4 percent among women who had secondary and higher education. The proportion of women who practiced FP was 17.7 percent among women who had primary education and the least percent 11.2 was observed among women with no education.

According to results of descriptive statistics in Table 4.1 out of those women who can‘t refuse sex 82.4percent practiced FP while the remaining 17.6percent didn‘t practiced family planning.

4.2. Results of Logistic Regression Analysis

Multiple logistic regression analysis was used to examine the effect of an independent variable in the model to study the status of FP practice methods, while controlling the other independent variables.

Accordingly, region, place of residence, age of a woman, religion of a woman, educational level of women, economic status, knowledge about FP method, visited by FP worker in the last 12 months before the survey, occupation of women, marital status, ability to refuse sex, exposure to mass media and number of living children of women were found to be significant predictors for women's family planning practice (see Table4.2).

Table 4. 2. Results of maximum likelihood estimates of parameters in fitting logistic Regression

LL (null model)= -4349.071

LL (saturated model)= -3091.448

Variables with categories	Coefficient	Std. Err.	Z	P>z	Odds Ratio	[95% Conf. Interval]	
						LB	UB
AGE			48.83	0.000*			
15-24	1.028459	.147194	6.99	0.000*	2.79675	2.09586	3.732035
25-39	.7120266	.124482	5.72	0.000*	2.03812	1.59687	2.601288
Above 39(ref)							
REGION			297.2	0.000*			
Tigray	.031256	.166316	0.19	0.851	1.03175	.744742	1.429364
Affar	-1.23588	.200214	-6.17	0.000*	.290579	.196264	.4302164
Amhara	.8356617	.183451	4.56	0.000*	2.30634	1.60979	3.304281
Oromiya	.0743993	.166637	0.45	0.655	1.07724	.777086	1.493321
Somali	-2.059331	.263474	-7.82	0.000*	.127539	.076098	.2137538
Ben-Gumuz	-1.128439	.209698	-5.38	0.000*	.323538	.214501	.4880011
SNNP	-.0462712	.152789	-0.30	0.762	.954783	.707702	1.288128
Gambela	-.1845687	.154946	-1.19	0.234	.831463	.613695	1.126504

Harari	-.0016756	.179876	-0.01	0.993	.998326	.701716	1.42031
Addis Ababa	1.262604	.185619	6.80	0.000*	3.53461	2.45665	5.08559
Dire dawa(ref)							
Place Of Resident			19.16	0.000*			
Urban	.4469714	.102105	4.38	0.000*	1.56357	1.27999	1.90998
Rural(ref)							
Education level			25.48	0.000*			
No education	-.5800048	.126681	-4.58	0.000*	.559896	.436793	.7176925
Primary	-.2530725	.112721	-2.25	0.025*	.776412	.622506	.9683679
Secondary and+(ref)							
Religion			64.40	0.000*			
Catholic	.0556994	.115181	0.48	0.629	1.05728	.843622	1.325049
Protestant	1.275951	.167175	7.63	0.000*	3.58211	2.58130	4.970941
Muslim	-.3631439	.298638	-1.22	0.224	.695486	.387336	1.248791
Orthodox(ref)							
Economic status			103.9	0.000*			
Poor	-.9596309	.094167	-10.2	0.000 *	.383034	.318479	.4606734
Middle	-.4653269	.108171	-4.30	0.000 *	.627929	.507967	.7762232
Rich(ref)							
No. of living children			93.91	0.000*			
No child	-1.224704	.12728	-9.62	0.000*	.293845	.228969	.377102
Small	.066109	.116666	0.57	0.571	1.06834	.849972	1.342817
Medium	.0606375	.093403	0.65	0.516	1.06251	.884769	1.275967
large(ref)							
Knowledge of FP method			52.22	0.000*			
Knows no method	-.8363247	.115735	-7.23	0.000*	.433300	.345362	.5436291
Knows							

method(ref)							
Visited by FP worker			17.81	0.000*			
No	-.3487781	.082643	-4.22	0.000*	.705549	.600042	.8296097
Yes(ref)							
Exposure To Mass media			30.82	0.000*			
No	-.4897543	.088221	-5.55	0.000 *	.612777	.515476	.7284446
Yes(ref)							
Women‘s occupation			27.14	0.000*			
Not working	-.1731316	.077645	-2.23	0.026*	.841027	.722301	.9792676
Agri employee	.4110968	.124103	3.31	0.001*	1.50847	1.18277	1.923862
Non-Agri employee (ref)							
Marital status			351.0	000*			
Never in union	.4304449	.124008	3.47	0.001*	1.53794	1.20610	1.961083
Married	-2.571922	.176725	-14.6	0.000*	.076389	.054026	.1080083
Living with partner	-1.514571	.146862	-10.3	0.000*	.219903	.164900	.2932505
Separated(ref)							
Ability to refuse sex			10.49	0.000*			
No	.9026518	.307449	2.94	0.003 *	2.46613	1.34994	4.505241
Unsure	.6551464	.287137	2.28	0.023 *	1.92542	1.09677	3.380163
Yes (ref)							
_cons	-1.207652	.383053	-3.15	0.002			

Note _*‘ indicates significance for p<0.05: The reference categories were selected subjectively considering previous research.

A negative sign in column labelled "Coefficient" indicates an inverse relationship of explanatory variable with the log odds of the dependent variable. In contrast a positive coefficient indicates a positive relationship to the log odds of the dependent variable.

To interpret the regression coefficient in logistic model we used odds ratio. The odds ratio indicates the effect of each explanatory variable directly on the odds of practicing family planning rather than on log (odds). Estimates of odds ratio greater than 1.0 indicate that women's status of FP practice is greater than that for the reference category. Estimates less than 1.0 indicate that women's status of FP practice is less than that for the reference category of each variable. So, the final model presented in Table 4.2 is interpreted in terms of odds ratio as follows.

The model revealed that women in the age group of 15-24 were 2.79 (OR=2.797) times more likely to practice family planning compared to the women in the age group of above 39 while women in the age group 25-39 were 2.04(OR=2.038) times more likely to practice family planning as compared to women in the age group above 39 controlling for other variables in the model.

Women who resided in the urban areas were 56.4 percent more likely to practice family planning compared with those from the rural areas controlling for other variables in the model(OR=1.564).

Women who resided in the Amhara region are 2.31 times more likely to practice family planning when compared with those residing in Dire Dawa controlling for other variables in the model (OR=2.306). Women who lived in Addis Ababa region were 3.53 times more likely to practice family planning compared to women in Dire Dawa controlling for other variables in the model(OR=3.53). Conversely, women who lived in Somali were 87.2 percent less likely to practice family planning compared to women in Dire Dawa (OR=0.128) and women who lived in Affar region were 70.9% less likely to practice family planning compared to women who lived in Dire Dawa controlling for other variables in the model (OR=0.291).

Women who were followers of Protestant religion were 3.58 times more likely to practice family planning compared to those Women who were followers of Orthodox religion(OR=3.582) controlling for other variables in the model.

Women who live in poor households were about 61.7% less likely to practice family planning than that of women who live in rich households(OR=0.383) and women who had medium wealth

were about 37.2% less likely to practice FP compared to women who were rich controlling for other variables in the model(OR=0.628).

Women who had no child were 70.6 percent less likely to practice family planning to women who had large number of children (OR=0.294) controlling for other variables in the model.

Women who had no education were 44.1 percent (OR=0.559) less likely to practice family planning compared to women who had secondary and higher education and Women who had primary education were 22.4 percent(OR=0.776) less likely to practice family planning compared to women had secondary and higher education controlling for other variables in the model.

Women who are not employed were 15.9(OR=0.841) percent less likely to practice family planning as compared to women who are non agriculture employee controlling for other variables in the model, while Women who are agriculture employee were 50.8(OR=1.508) percent more likely to practice family planning compared to women who are non agriculture employee.

Women who were not exposed to mass media messages via Radio, TV or newspapers/magazine were 38.7% less likely to practice family planning compared to those women who were exposed to mass media messages via radio, TV or newspapers/magazine (OR=0.613) controlling for other variables in the model.

Women who were not visited by a family planning worker during the last 12 months were 29.4% less likely to practice family planning than those who were visited during the last 12 months before the survey (OR=0.706) controlling for other variables in the model. Similarly those women who had no knowledge about family planning methods were 56.7% less likely to practice family planning compared to women who had knowledge about family planning methods controlling for other variables in the model(OR=0.433).

Women who were never in a union were 53.8 percent more likely to practice family planning compared to those women who were no longer living with partner(OR=1.538) controlling for other variables in the model. In contrast women who are married were 92.4 percent less likely to practice family planning compared to those women who were no longer living with partner

(OR=0.0764) and those women who are living with partner were 78.1 percent less likely to practice family planning compared to those women who were no longer living with partner (OR=0.219) controlling for other variables in the model.

Finally those women who couldn‘t refuse sex were about 2.47 times more likely to practice family planning as compared to those who could refuse sex(OR=2.47) controlling for other variables in the model.

According to Table 4.2 as mentioned above region, place of residence, age of a woman, religion of a woman, educational level of women, economic status, knowledge about FP method, visited by FP worker in the last 12 months before the survey, occupation of women, marital status, ability to refuse sex, exposure to mass media and number of living children of women were found to be significant predictors for women‘s family planning practice.

Thus, from the above table the estimated model is given by:

$$logit(\hat{P}) = \beta_o + \sum_{i=1}^{11} \beta_{1i}\, REGW_i + \sum_{j=1}^{2} \beta_{2j}\, RESW_j + \sum_{k=1}^{3} \beta_{3k} AGEW_{\mathrm{k}} + \sum_{l=1}^{5} \beta_{4l} RELW_l + \sum_{m=0}^{2} \beta_{5m} EDUW_m + \sum_{n=1}^{3} \beta_{6n} ESW_n + \sum_{o=0}^{1} \beta_{7o} KNGo + \sum_{p=0}^{1} \beta_{8p} VISTD_p + \sum_{q=0}^{2} \beta_{9q}\, OCCUP_q + \sum_{r=0}^{1} \beta_{10r}\, EXPSR_r + \sum_{s=0}^{3} \beta_{11s} NCHIL_s + \sum_{t=0}^{3} \beta_{12t} MARSTA_t + \sum_{u=0}^{1} \beta_{13u} REFUSE_{\mathrm{u}}$$

Where:

$\hat{P}$= predicted probability of FP practice, β_0 = constant, $REGW_i$ = women's region at level i, $RESW_j$= women's place of residence at level j, $AGEW_k$= age of a woman at level k, $RELW_l$ = religion of a woman at level l, $EDUW_m$= educational level of women at level m, ESW_n = economic status of women at level n, $KNGo$ = knowledge about any FP method at level o, $VISTD_p$= visited by FP worker in the last 12 months at level p, $OCCUP_q$ = women‘s occupation at level q, $EXPSR_r$ =exposure to mass media at level r,

$NCHIL_s$ = number of living children of women at level s, $MARSTA_t$ = maritaal status at level t, $REFUSE_u$ = ability to refuse sex at level u.

The value of explanatory variable for each category is taken as 1 if this variable falls in the corresponding category. For example,

$REGW_i$ = 1 for women's region of level = i and $REGW_i$= 0 for other levels.
$RESW_j$= 1 women's place of residence of level = j and $RESW_j$=0 for other levels.

Similarly, each of the other variables takes value 1 if it falls within the corresponding level of category. Based on the above result, the regression equation consisting of the significant variables is given by:

$$\begin{aligned}\text{logit}(\widehat{\text{P}}) = &-1.207652 + .03126\text{REGW}_1 - 1.2359\text{REGW}_2 + \cdots + 1.2626\text{REGW}_{10} \\ &+ .44697\text{RESW}_1 + 1.0285\text{AGEW}_1 + .71203\text{AGEW}_2 + .05569\text{RELW}_1 \\ &+ 1.2759\text{RELW}_2 - .36314\text{RELW}_3 - .5800\text{EDUW}_0 - .25307\text{EDUW}_1 \\ &- .9596\text{ESW}_1 - .4653\text{ESW}_2 - .8363\text{KNGo} - .3488\text{VISTD}_0 + .4304\text{MARSTA}_0 \\ &- 2.5719\text{MARSTA}_1 - 1.5146\text{MARSTA}_2 - .4898\text{EXPSR}_0 - 1.2247\text{NCHIL}_0 \\ &+ .06611\text{NCHIL}_1 + .06064\text{NCHIL}_2 - .1731\text{OCCUP}_0 + .4111\text{OCCUP}_1 \\ &+ .9027\text{REFUSE}_0 + .6551\text{REFUSE}_1\end{aligned}$$

4.2.1. Goodness of Fit and Model Diagnostics for logistic regression

4.2.1.1. Goodness of fit of the logistic regression Model

After a logistic regression model has been fitted, a global test of goodness of fit of the resulting model should be performed. It is necessary to see the appropriateness, adequacy and usefulness of the fitted model. The most commonly used techniques are Pearson's Chi-square, Hosmer-Lemeshow test and the Wald goodness of fit test.

Likelihood-Ratio Test

The likelihood ratio test is used to test the goodness of fit of the model by comparing two nested models:-one with small number of explanatory variables and the other with more explanatory

variables. Two models will be compared: one with no variable called empty (intercept only) model and the other with all variables called saturated (full) model.

The null hypothesis is:

H_0: There is no significant difference between the empty model and the saturated model.

H_A: not H0

Goodness of fit measure	Empty model	Full model
Log Likelihood	-4349.071	-3091.448
AIC	8700.141	6250.896
BIC	8707.369	6496.641

From the above table we see that -2 Log Likelihood statistics for the full model is 6179.0968. The statistic for the model that had only the intercept is $-2LL_0$=8698.142. The inclusion of the parameters reduced the -2 Log Likelihood statistics by 8698.142–6182.896=2515.246 Since log likelihood ratio test is Chi-square distributed with 35 degrees of freedom (χ^2=2515.246, d.f=33 p-value<0.000), we can reject the null hypothesis of no significant difference between the two models. We use AIC and BIC values to determine the better model. The above table shows that the full model is better than the empty model since AIC and BIC are smaller than for the empty model.

Hosmer-Lemeshow Goodness of Fit

The Hosmer-Lemeshow goodness of fit test divides subjects into deciles based on predicted probabilities, then computes a chi-square from observed and expected frequencies (in a 10×2 Table). A non significant chi-square indicates that there is no difference between the observed and the model predicted values and hence estimates of the model adequately fit the data. The overall goodness of fit of the model was evaluated by Hosmer-Lemeshow goodness of fit test with the null hypothesis:

H_0: the model is a good fit

H1: the model is not a good fit

Since the p-value is 0.359 greater than 0.05, we don‘t reject the null hypothesis that there is no difference between observed and model-predicted values, implying that the model's estimates fit the data at an acceptable level (see Table 4.3).

Table 4.3: Hosmer-Lemeshow Goodness of Fit Statistics

Hosmer-Lemeshow Goodness of Fit test		
Chi-Square	DF	Sig.
8.806	8	.359

4.2.1.2. Model diagnostics: influential observations and outliers

The adequacy of the fitted model was checked for possible presence of outliers and influential values. The diagnostic test results for detection of outliers and influential values are presented in Appendix A. The DFBETAs for model parameters including the constant term and Cook‘s influence statistic were both less than unity. DFBETAs less than unity imply no specific impact of an observation on the coefficient of a particular predictor variable, while 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 shows that no subject has a substantial large impact on the predicted values of the model. Thus, from the above goodness of fit tests and diagnostic checking, we can say that our model is adequate (see Appendix A).

4.3. Results of Multilevel Logistic Regression Analysis

The first step in performing a multilevel analysis is testing the heterogeneity of proportions between groups (regions). Chi-square test statistic was applied to assess heterogeneity in the proportion of individuals among regions. The test yield χ^2 (10) = 718.3829 with P=0.000<0.05, where 10 is the degrees of freedom. Thus, there is an evidence of heterogeneity of individuals among regions.

4.3.1. Random Intercept Only Model

This is the type of model that incorporates only the grand mean and random intercept (regional effect) without covariate. The model is given as:

$$logit(P_j) = \beta_o + U_{oj}$$

U_{0j} ~IID $(0,^2_u)$

The intercept β_o also known as the grand mean is shared by all regions while the random effect U_{0j} also known as level two residual is specific to region j. It shows how the mean of Women's FP practice in a particular region deviates from the grand mean.

Table 4. 4 Result of Parameter Estimate of Random Intercept-Only Model

FP	Coef.	Std. Err.	z	P>|z|	[95% Conf.Interval]	
_cons	-1.795676	.2885214	-6.22	0.000	-2.361	-1.230

Random-effects Part	Estimate	Std. Err.	[95% Conf. Interval]	
REG: Identity				
var(_cons)	.9017	.3956	.3816	2.1307

LR test vs. logistic regression: chi bar2 (01) = 621.72 Prob>=chibar2 = 0.0000

Model	Obs	ll(null)	ll(model)	Df	AIC	BIC
.	10176	.	-4038.209	2	8080.418	8094.874

Table 4.4 shows the output of the estimates of fixed effects and random effects. From the table we can see that the estimate of the fixed part of the model is -1.795 with z-value of -6.22 and p-value of 0.000 which implies that the average log odds of FP practice is significantly different from zero. The intercept informs us $\widehat{\beta}_0 = -1.795$ that the average probability of FP practice is $\frac{\exp(-1.795)}{1+\exp(-1.795)} = 0.1425$ which means the chance of FP practice is 14.25% on average.

The table also contains the variance estimate of random effects at regional level, $\sigma_u^2 = .9017$ with confidence interval of (.3816 , 2.1307) which implies that the between region variance of FP practice is .9017 and reveals that there is a significant difference in FP practice among women across regions. This implies that multilevel model is more appropriate relative to single level. At the bottom of the table there is the result of the hypothesis H0: $\sigma_u^2 = 0$ is provided showing that there is no cross-regional variation in FP practice. For this hypothesis, we see that

the value of the test statistic is 621.72 with p = 0.0000 Therefore, the null hypothesis is rejected and there is evidence of heterogeneity or cross-regional variation in FP practice.

We can now write the model for the jth region as logit(π_j) =-1.795 +U_{0j}. From the model we can say that the average probability of FP practice in the absence of covariates in region j is less than the average when U0j is negative while it is higher than the average when U_{0j} is positive.

The empty model with random effect also helps to calculate the between region variations by the help of intra –class correlation coefficient (ICC) which is the measure of the correlation between two individuals who are in the same higher level unit (region). ICC for this model is calculated by using formula (3.25). A low ICC indicates relatively small between region variations. From the table we have between regions variance of 0.9017 and level one variance of $\frac{\pi^2}{3} = 3.29$. Intra-class correlation coefficient is 0.2151. The ICC for this model implied that 21.51% of the variation in FP practice can be explained by grouping the women in regions .The remaining (100-21.51%=78.49%) of the variation of in FP practice is explained within region-lower level units.

4.3.2. Random Intercept and Fixed Effect Model

In a random intercept and fixed coefficient multilevel logistic regression model, we allowed the probability of FP practice to vary across regions, but we assumed that the effects of the explanatory variables are the same for each region. That is, the random intercept varies across regions, but women level explanatory variables are fixed across regions.

Table 4. 5 Result of Parameter Estimate of Random Intercept and Fixed Slope Model

FP	Coefficient	Std.Er.	Z	P>z	Odds Ratio	[95% Conf. Interval	
						LB	UB
AGE				0.000*			
15-24	1.022209	.14709	6.95	0.000*	2.779328	2.08324	3.708013
25-39	.7090184	.12439	5.70	0.000*	2.031996	1.59234	2.593037
Above 39 (ref)							

Place of Residence							
Urban	.4434791	.10175	4.36	0.000*	1.558119	1.27641	1.902002
Rural(ref)							
Religion							
Catholic	.0654695	.11493	0.57	0.569	1.06766	.852323	1.337401
Protestant	1.279905	.16680	7.67	0.000*	3.596296	2.59341	4.987004
Muslim	-.3548814	.29860	-1.19	0.235	.7012566	.390578	1.25906
Orthodox(ref)							
Economic status							
Poor	-.9618624	.09410	-10.2	0.000*	.3821804	.317809	.4595892
Middle	-.4636362	.10816	-4.29	0.000*	.6289923	.508842	.777513
Rich(ref)							
No. of living children							
No child	-1.223013	.12714	-9.62	0.000*	.2943419	.229420	.3776348
Small	.0601552	.11656	0.52	0.606	1.062001	.845096	1.334579
Medium	.058705	.09333	0.63	0.529	1.060462	.883173	1.273342
Large(ref)							
Knowledge of FP method							
Knows no method	-.8349111	.11537	-7.24	0.000*	.433913	.346099	.5440072
Knows method(ref)							
Visited by family planning worker							
No	-.3506807	.08258	-4.25	0.000*	.7042086	.598979	.8279255
Yes(ref)							

Education level							
No education	-.5837035	.12651	-4.61	0.000*	.5578286	.435329	.7147996
Primary	-.2533037	.11256	-2.25	0.024*	.7762321	.622559	.9678388
Secondary and +(ref)							
Exposure to mass media							
No	-.4906816	.08813	-5.57	0.000*	.612209	.515088	.7276427
Yes(ref)							
Marital status							
Never in union	.4304056	.12402	3.47	0.001*	1.537881	1.20603	1.961048
Married	-2.569082	.17649	-14.6	0.000*	.0766058	.054205	.108265
Living with partner	-1.516662	.14677	-10.3	0.000*	.2194431	.164585	.2925868
Separated (ref)							
Occupation							
Not working	-.1775216	.07764	-2.29	0.022*	.8373429	.719144	.9749697
Agri-employee	.4077412	.12396	3.29	0.001*	1.503418	1.17914	1.916881
Non-Agri employee(ref)							
Ability to refuse sex							
No	.8879043	.30719	2.89	0.004*	2.430032	1.33089	4.436933
Not sure	.6401014	.28693	2.23	0.026*	1.896673	1.08083	3.328344
Yes(ref)							
_cons	-1.400967	.44622	-3.14	0.002*			

Random-effects Parameters	Estimate	Std. Err.	[95% Conf.	Interval]
REG: Identity				
var(_cons)	.7605	.339	.3177	1.8204
LR test vs. logistic regression: chibar2(01) = 310.33 Prob>=chibar2 = 0.0000				

Note _*‘ indicates significance for p<0.05:

Model	Obs	ll(null)	ll(model)	df	AIC	BIC
	10176		-3119.148	25	6288.296	6468.99

Table 4.6 Results of Model Selection Criteria and Log Likelihood Ratio Test

	Random Intercept Only Model	Random Intercept with Fixed Effects Model
Log likely hood(LL)	-4038.209	-3119.148
-2LL=deviance	8076.418	6238.296
AIC value	8080.418	6288.296
BIC value	8094.874	6468.99
Wald test	Wald chi2(23)=1202.96 Prob > chi2 = 0.0000	

Table 4.5 contains estimates of the fixed slopes and associated odds ratios. Values of the Wald test statistic used for testing for the significance of individual predictors are given in the 4th column with the corresponding p-values in the 5th column. The Wald test of overall goodness of fit gives Wald chi2 (23) =1202.96with p =0.000 where 23 is the degrees of freedom. This indicates that all explanatory variables jointly are significant. From the table we see that the inclusion of level one covariates decreased regional variations from .9017(level-two variance without covariates) to .7605, it indicates that there is a significant variation between regions in women FP practice.

The deviance of the random intercept model, 8076.418is reduced to 6238.2958 when we include covariates for the same random intercept with fixed slope which implies that the random intercept with fixed slope model is better than the random intercept only model. The BIC and AIC values in Table 4.6 also ensure this as the smaller the values of AIC and BIC the better the model is.

Moreover, the values of chi2 (1) =310.33and p=0.0000 (see Table 4.5) lead to the rejection of the null hypothesis that the random effect is zero as in the assumption of ordinary logistic regression. From this we can conclude that the random effect at regional level is significantly different from zero.

From Table 4.5 we see that all categories of age of woman (15-24 and 25-39) are significant for FP practice as compared to the reference category. In addition number of living children (no child) significant factors for FP practice as compared to their reference categories. Additionally Women‘s educational level (no education and primary), knowledge about FP , economic status(poor and medium), visited by FP workers, exposure to mass media, Religion (only protestant) ,marital status, occupation place of residence significantly affects FP practice compared to their reference categories.

4.3.3. The Random Coefficient Model

Multilevel logistic regression can allow the coefficient of level-one covariates to vary across regions instead of keeping them fixed across regions. Now we are going to see the effect of women‘s level covariates by allowing them to vary randomly across regions. This model contains fixed effects and random effects. The fixed effects are analogous to standard logistic regression coefficients and are estimated directly. The random effects are not directly estimated but are summarized in terms of their estimated variances and covariance. The random effects can take random intercepts (regional effects) and random coefficients (level-one covariates effect). In this section we investigate whether level-one covariates have random effects across regions or they have the same effects across regions. Estimates of this model show that the random slope variances of all included variables except for place of residence and exposure to mass media were approximately zero. This indicates that only the effects of place of residence and exposure to mass media on family planning practice varied across regions whereas the effect of other

covariates for family planning practice remained fixed across regions. The results of the random coefficient estimates are given in Table 4.7 below.

Table 4. 7 Result of Parameter Estimate of Random Coefficient Model

FP	Coefficient	Std. Err.	Z	P>|z|	Odds Ratio	[95% Conf. Interval]	
						LB	UB
AGE							
15-24	1.003727	.1479584	6.78	0.000*	2.728432	2.0416	3.646326
25-39	.703598	.1246798	5.64	0.000*	2.021011	1.582855	2.580455
Above 39(ref)							
Religion							
Catholic	.1268732	.1164967	1.09	0.276	1.135273	.9035207	1.42647
Protestant	1.371248	.1724578	7.95	0.001*	3.940265	2.810148	5.524866
Muslim	-.2867907	.3009567	-0.95	0.341	.7506688	.4161727	1.354014
Orthodox(ref)							
Economic status							
Poor	-.912266	.0960274	-9.50	0.000*	.4016131	.3327126	.4847821
Middle	-.4726513	.1092737	-4.33	0.000*	.6233474	.5031717	.7722255
Rich(ref)							
No. of living children							
No child	-1.258352	.1282042	-9.82	0.000*	.284122	.2209923	.3652855
Small	.0581117	.1173621	0.50	0.620	1.059833	.8420518	1.33394
Medium	.0664261	.0943336	0.70	0.481	1.068682	.8882835	1.285717
large(ref)							

Knowledge of FP method							
Knows no method	-.8126505	.1185353	-6.86	0.000*	.4436805	.3517004	.5597161
Knows method(ref)							
Visited by family planning worker							
No	-.3604372	.0829302	-4.35	0.000*	.6973713	.5927531	.8204543
Yes(ref)							
Education level							
No education	-.6410625	.1272144	-5.04	0.000*	.5267325	.4104923	.6758888
Primary	-.2894587	.1130425	-2.56	0.010*	.7486687	.5998847	.9343543
Secondary and + (ref)							
Marital status							
Never in union	.4176941	.1252609	3.33	0.001*	1.518456	1.1879	1.940996
Married	-2.538551	.1764158	-14.4	0.000*	.0789808	.0558928	.1116058
Living with partner	-1.506359	.1470093	-10.3	0.000*	.2217157	.1662118	.2957542
Separated (ref)							
Occupation							
Not working	-.1079267	.0786863	-1.37	0.170	.8976934	.7693963	1.047384
Agri-employee	.4351907	.1240811	3.51	0.000*	1.545258	1.211666	1.970693
Non Agri-employee(ref)							
Ability to refuse sex							
No	.8757823	.3093931	2.83	0.005	2.400753	1.309156	4.40254
Not sure	.6172234	.2875967	2.15	0.032	1.853774	1.055004	3.257313

Yes (ref)				
_cons	-.8891965	.4396446	-2.02	0.043

Note _*' indicates significance for p<0.05:

Random-effects Parameters	Estimate	Std.Err.	[95% Conf. Interval]	
REG: Unstructured				
var(RES)	.5652645	3360056	.1763108	1.812277
var(EXPSR)	.9503441	.4732041	.3581317	2.521849
var(_cons)	.9715831	.6766359	.2481309	3.804337
cov(RES,EXPSR)	-.4947274	.320256	-1.122418	.1329628
cov(RES,cons)	.0630207	.319691	-.5635619	.6896033
cov(EXPSR,_cons)	-.5440012	.465736	-1.456827	.3688247

LR test vs. logistic regression: chi2(6) = 444.08 Prob > chi2 =0.000

In Table 4.7 the value of Var(RES) and Var(EXPSR) are the estimated variance of residence and exposure to mass media respectively. These estimated variances indicated that there is a significant variation in the effect of residence and exposure to mass media across regions in Ethiopia.

The estimate of the fixed intercept is -.88919 and the log-odds of the probability of family planning practice when all level one covariates are zero in region j is given by -.88919 +$\hat{u}_j$ where $\hat{u}_j$ is a random intercept with variance of .9715831(indicated in the table as var(cons)) which is the between-regions variance and standard error .676635. In the absence of level-one covariates, the status of each region on FP practice as compared to the average FP practice measured with log odds depends on the sign of the random intercept, $\hat{u}_j$. When $\hat{u}_j$ is positive the log odds of FP practice is higher than the average and when $\hat{u}_j$ is negative the log odds of FP practice is less than the average. The individual region slopes of place of residence and Exposure to mass media vary with variance .5653 and .9503 respectively.

Generally, interpretation of significant covariance terms can be easily made in terms of the correlation coefficients between random intercept and random slopes. Positive correlation between intercept and slopes implies that regions with higher intercepts tend to have on average higher slopes. The negative sign for the correlation between intercepts and slopes implies that regions with higher intercepts tend to have on average lower slopes on the corresponding predictors.

Table 4. 8 Random-Effects Correlation Matrix for Level Region

	RES	**EXPSR**	**Cons**
RES	1		
EXPSR	-0.675	1	
Cons	0.085	-0.566	1

In order to see whether the inclusion of level one covariates with place of residence and Exposure to mass media varying across regions significantly improved the random intercept only model, log likelihood ratio test, AIC and BIC values have been used.

The likelihood ratio test results are LR = 1911.19 (which is the difference between the deviance of random intercept only model and random coefficient model; 8076.418- 6165.228) and p= 0.000 implying that there is a significant difference between the two nested models. The AIC(6221.229)and BIC(6423.607) values for the random coefficient model are less than the corresponding AIC(8080.418) and BIC(8094.874**)** values for the random intercept only model indicating that the random coefficient model is better than random intercept only model (see table 4.9 & 4.4).

Table 4. 9 Results of Model Selection Criteria and Log Likelihood Ratio Test

	Random Intercept and Fixed Slope Model	**Random Coefficient Model**
Log likely hood(LL)	3119.148	-3082.614
-2LL=deviance	6238.296	6165.228
AIC value	6288.296	6221.229

BIC value	6468.99	6423.607
Likelihood-ratio test		LR = 1911.19
(Assumption: m2 nested in m1)		Prob > chi2 = 0.0000

The likelihood ratio test of random intercept with fixed effect model versus random coefficient model yields LR chi2 = 73.068 which is the difference between the two deviances and p =0.000 which implies that the null hypothesis of no difference between the two models is rejected. Both the AIC (6288.296) and BIC (6468.99) values of the random intercept with fixed effect model in table 4.9 are greater than the AIC (6165.228) and BIC (6423.607) values of the random coefficient model indicating that the random coefficient model is preferred model.

The parameters of observed variables can be interpreted much the same way as those from the standard logit model. Thus, everything else being equal except slight difference on random effect in the model women who were followers of protestant religion 3.94 times more likely to practice FP than those women who were followers of orthodox controlling for other variables in the model and random effect at level two(OR=3.940).Similarly the model revealed that women in the age group of 15-24 were 2.73 (OR=2.728) times more likely to practice family planning compared to the women in the age group of above 39 while women in the age group 25-39 were 2.02(OR=2.02) times more likely to practice family planning as compared to women in the age group above 39 controlling for other variables in the model and random effect at level two.

On the other hand women who had no education were 47 percent (OR=0.526) and women who had primary education were 25 percent (OR=0.746) less likely to practice FP than those women with secondary and higher education controlling for other variables in the model and random effect at level two. Women who were not employed were 10.23(OR=0.8977) percent less likely to practice family planning as compared to women who were non agriculture employee, while Women who were agriculture employee were 54.5(OR=1.545) percent more likely to practice family planning compared to women who were non agriculture employee controlling for other variables in the model and random effect at level two.

4.3.4. Goodness of Fit Test

An overall evaluation of the multilevel logistic model was assessed using the deviance. The test is done by comparing the deviance of two models by subtracting the smaller deviance from the larger deviance. The difference is a chi-square with the number of degrees of freedom equal to the number of different parameters in the two models. The significance of this chi square indicates that the model is a good fit. Similarly, it was also assessed by using AIC and BIC. Based on Table 4.9 random coefficient model have a significant deviance chi-square and the value of AIC and BIC are less than from the random intercept with fixed slope model and Random Intercept Only Model So, we conclude that the random coefficient model is a good fit.

4.3.5. Diagnostic Checking

The diagnostic test results for detection of outliers and influential values are presented in Appendix. Based on the results the value of leverage and influential observation is less than one. Thus, from the goodness of fit test and diagnostic test results presented in the Appendix, we can say that the fitted model is adequate.

CHAPTER FIVE

5. DISCUSSION, CONCLUSTION AND RECOMMENDATION

5.1. DISCUSSION

This study is an attempt to identify some determinants of women's family planning practice based on Ethiopian Demographic and Health Survey (EDHS 2011) data. Accordingly descriptive analysis, multiple logistic regression and multilevel logistic regression techniques were used. Based on the findings of previous results, this study made a few comparative discussions as follows.

At first the study included fourteen predictor variables that were categorized under socioeconomic, demographic and other proximate characteristics. The descriptive analysis of the study revealed that only 15.3 percent of the sample women were practicing family planning methods and 84.7 percent did not practice family planning.

The model revealed that women in the age group of 15-24 were (OR=2.797) more likely to practice family planning compared to the age group of above 39 and Women in the age group 25-39 were (OR=2.04) more likely to practice family planning as compared to women in the age group of above 39. In our analysis, younger women were more likely to practice FP than older women. This is an encouraging result which has implications on promising future trends of family planning utilization. The prominent reason for this finding might be women at the older age of reproduction and they might have perceived not to be at risk of pregnancy. The other reason could be older women are more likely to practice sex infrequently or that women usually stop practicing family planning methods in their older ages in order to have children. This finding is consistent with other studies: Anna and Nassoro, 2006; NFHS-III, 2007; Mohanan et al., 2003.

Similarly, place of residence is a significant factor contributing to practicing family planning. Women who resided in the urban areas were more likely to practice family planning as compared with those from the rural areas (OR=1.564). The explanation for this could be easier accessibility of family planning services in cities, the desire for more children in rural areas, and the greater

education in urban areas. Studies elsewhere revealed a similar pattern of relationship between residence and FP practice (Bogale et al., 2011 and Kebede , 2006).

Furthermore the study also revealed there is significant association with exposure to mass media and FP practice women who were not exposed to mass media messages via Radio, TV or newspapers/magazine were less likely to practice family planning compared to those women who were exposed to mass media messages via radio, TV or newspapers/magazine (OR=0.613). These result was consistent with study performed in Goa revealed that the use of family planning methods was found to be positively correlated with women's exposure to information on family planning methods in television, radio, or newspapers (Kulkarni, 2003).

Regarding the regional variations in family planning practice the study revealed that woman who lived in Afar and Somali practice family planning methods less than women who live in other regions of Ethiopia.

The results of this study also showed that women's economic status is an important factor associated with FP. women who lived in poor household were less likely to practice family planning than those women who were rich (OR=0.383) and the odds of family planning practice for women who had medium wealth was 0.628 times lower compared to women who were rich. Similarly a study conducted by Westoff in 2012 found that use of family planning is higher for the highest wealth quintile as compared to the lowest wealth quintile. This finding is consistent with past studies Ettarh, 2011; Gakidou and Vayena, 2007; Sathar & Zaidi, 2010; Laya, 2012; NFHS-III, 2007 and Mohanan, 2003.

This study also revealed a statistically significant association between FP practice and women's education level. Women who had no education were (OR=0.559) less likely to practice family planning compared to women who had secondary and higher education and Women who had primary education were also (OR=0.776) less likely to practice family planning compared to women had secondary and higher education . The reason might be longer years of education could probably give women better chance to understand uses of FP practice to reduce fertility, maternal and child morbidity and mortality. Also educated women could avoid the negative effects of family planning methods by getting appropriate advice from a service provider thereby increased their consistent use. A number of studies show that education of women is

significantly associated with FP practice. For instance, in Kenya women with primary incomplete education were twice less likely to experience an unmet need for family planning compared to those with primary complete or higher education (Wafula and Ikamari, 2007). Similarly a study conducted in Mojo town on Family planning service utilization revealed that Women who attained secondary and higher level of education were found to be more likely to have the intention to practice Family planning compared to women who had no education, respectively (Gizaw and Regassa, 2011). Also Similar results have been reported from earlier studies (Laya, 2012 ; Sengupta, & Das, 2012; Assefa and Fikrewold, 2011; Babalola and Fatusi 2009; Beekle and McCabe, 2006; Fantahun M, 2006).

Marital status is one of the factors that had significant association with FP in this study. Women who were never in a union were more likely to practice family planning compared to those women who were no longer living with partner(OR=1.534). In contrast women who are married were less likely to practice family planning compared to those women who were no longer living with partner (OR=0.076) and also those women who are living with partner were less likely to practice family planning compared to those women who were no longer living with partner (OR=0.219).

Another important factor that significantly affects FP practice is knowledge of FP method. The study revealed that women who had no knowledge about family planning methods were less likely to practice family planning compared to women who had knowledge about family planning methods(OR=0.433). This finding is consistent with research findings in Ethiopia (Girma, 2011)and abroad (Lwelamira et al., 2012).

The study also found women who were not visited by a family planning worker during the last 12 months were less likely to practice family planning than those who were visited during the last 12 months before the survey (OR=0.706).This result is consistent with studies made in Ethiopia and India(Antenane, 2002 and Laya, 2012).

As far as the religion is concerned, a significant association has been observed between religion and FP practice in the study. Women who were followers of Protestant religion were more likely to practice family planning compared to those Women who were followers of Orthodox religion (OR=3.582). A consistent result was found using data from the Butajira District in South Central

Ethiopia, Wubegzier and Alemayehu reported that religion was one of the determinants of family planning(Wubegzier and Alemayehu 2012). Other similar findings found in Srivastava et al., 2011; . Barman, 2013 and Najafi, et al., 2011.

The study also revealed that FP practice and number of living children are significantly associated. Women who had no child were less likely to practice family planning to women who had large number of children (OR=0.294). This finding is in line with study results by Assefa and Fikrewold (2011) for the SNNPR which identified that Women with living children are significantly more likely to practice FP than women with no living children. Similar findings were obtained in Barman, 2013; Kumar& Singh, 2013 and Laya, 2012.

This study has found that occupation of women is significantly associated with the practice of FP. Women who are not employed were (OR=0.841) less likely to practice family planning as compared to women who are non agriculture employee. These result is in line with findings in India and Ghana(Aryeetey et al., 2010 and Kumar et al., 2010).

5.2. CONCLUSION

The descriptive results show that more than 80% of the respondents (women) in the study do not practice family planning methods.

The findings of this study identified that region, place of residence, age of a woman, religion of a woman, educational level of women, economic status, knowledge about FP method, visited by FP worker in the last 12 months before the survey, occupation of women, marital status, ability to refuse sex, exposure to mass media and number of living children of women were significant predictors for women‘s family planning practice.

Even though women have information about FP methods they do not practice it due to religion, economic status, place of residence and so on. Uneducated women were less likely to practice FP than educated women while women in urban areas were more likely to practice FP than their rural counterparts.

The multilevel logistic regression showed that only the effects of place of residence and exposure to mass media varied across regions whereas the effect of other covariates for women family planning practice remained fixed across regions.

5.3. RECOMMENDATIONS

Based on the findings the following are recommended in order to increase women's FP practice:

- The government should give more attention to improve the practice of FP to those regions with low rates of practice like Affar and Somali regions.
- Since women exposed to FP information in any way were more likely to practice FP the government and non-government organization involved with FP should enhance information and communication activities regarding family planning services using mass media, family planning workers and health centres.
- Since there are variations in women's family planning practice based on residence the government should give more emphasis to improve the FP service delivery in rural areas.

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7. APPENDIXES

Appendix A: Result of Diagnostic Tests for Outliers and Influential Value for Standard logistic regression analysis of women's family planning practice

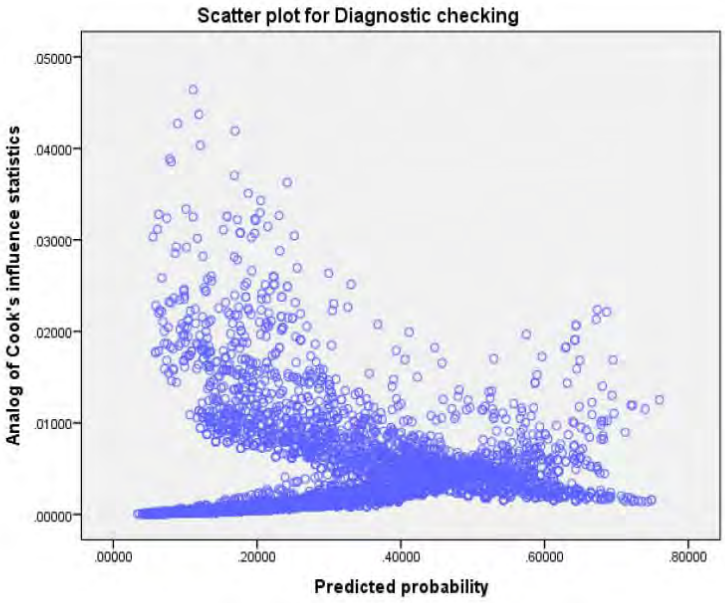
Descriptive Statistics

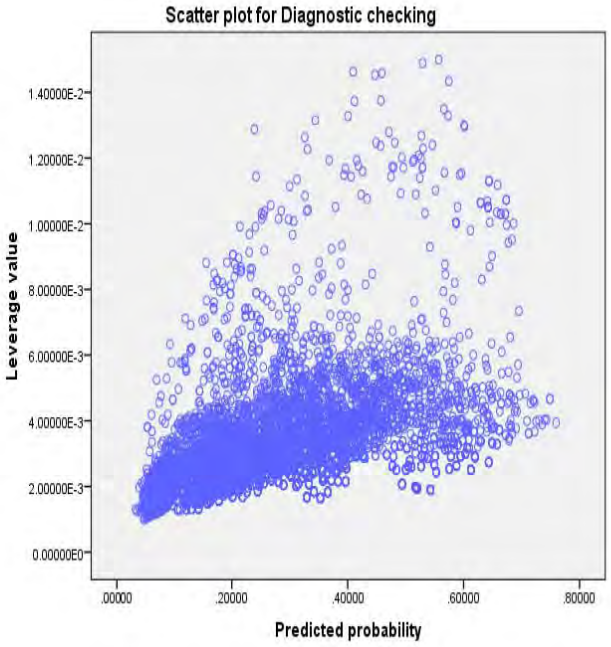
	N	Minimum	Maximum	Mean	Std. Deviation
Analog of cook's value	10176	.00000	.11765	.0034581	.00890791
Leverage value	10176	.00001	.02780	.0033412	.00308438
DFBETA for constant	10176	-.06696	.08368	-2E-7	.00412948
DFBETA for AGE(1)	10176	-.01565	.01050	1E-7	.00146985
DFBETA for AGE(2)	10176	-.01397	.01010	1E-7	.00125517
DFBETA for REG(1)	10176	-.01676	.01680	0E-7	.00172383
DFBETA for REG(2)	10176	-.01724	.03292	2E-7	.00204556
DFBETA for REG(3)	10176	-.01888	.01493	0E-7	.00195323
DFBETA for REG(4)	10176	-.01729	.01488	0E-7	.00171617
DFBETA for REG(5)	10176	-.01655	.05673	2E-7	.00265846
DFBETA for REG(6)	10176	-.01689	.03072	-1E-7	.00224254
DFBETA for REG(7)	10176	-.01659	.01122	1E-7	.00157656
DFBETA for REG(8)	10176	-.01437	.01322	0E-7	.00161859
DFBETA for REG(9)	10176	-.01675	.02229	1E-7	.00190905
DFBETA for REG(10)	10176	-.02555	.01884	1E-7	.00185911

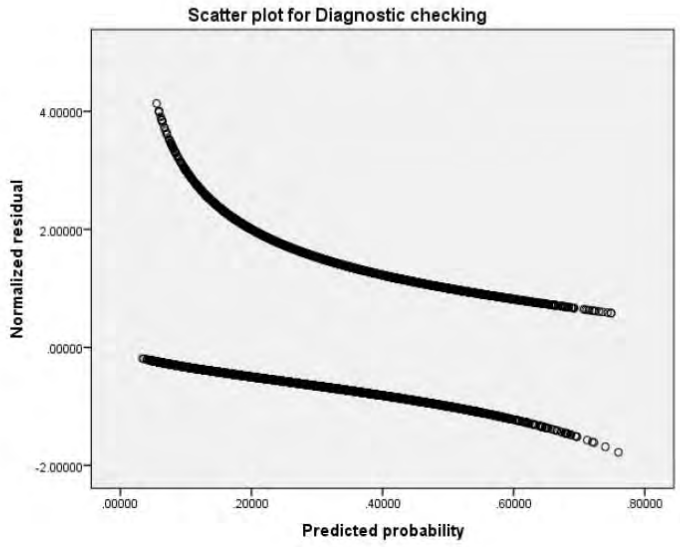
DFBETA for RES(1)	10176	-.00933	.00981	0E-7	.00103154
DFBETA for EDU(1)	10176	-.01271	.01181	0E-7	.00127997
DFBETA for EDU(2)	10176	-.01049	.00827	0E-7	.00113824
DFBETA for REL(1)	10176	-.01027	.01001	0E-7	.00117077
DFBETA for REL(2)	10176	-.01450	.01464	-1E-7	.00171945
DFBETA for REL(3)	10176	-.02970	.08387	0E-7	.00301184
DFBETA for ECOSTA(1)	10176	-.00658	.00683	0E-7	.00096017
DFBETA for ECOSTA(2)	10176	-.00533	.01133	0E-7	.00106957
DFBETA for NLCHIL(1)	10176	-.01418	.01578	-1E-7	.00129909
DFBETA for NLCHIL(2)	10176	-.01147	.01092	-1E-7	.00115695
DFBETA for NLCHIL(3)	10176	-.00612	.00687	0E-7	.00092050
DFBETA for KNG(1)	10176	-.00754	.01250	2E-7	.00112785
DFBETA for VISTD(1)	10176	-.00625	.00533	0E-7	.00084766
DFBETA for MARSTA(1)	10176	-.01034	.01259	0E-7	.00127103
DFBETA for MARSTA(2)	10176	-.01501	.03020	0E-7	.00183176
DFBETA for MARSTA(3)	10176	-.01200	.02402	-2E-7	.00158476
DFBETA for OCCUP(1)	10176	-.00520	.00574	0E-7	.00077041

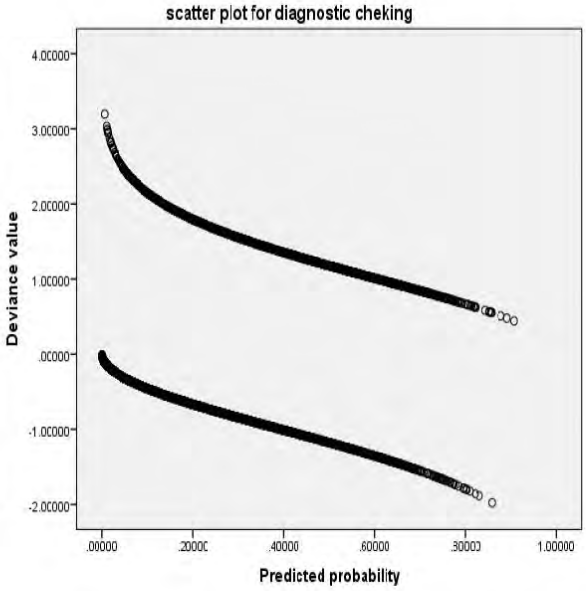
DFBETA for OCCUP(2)	10176	-.00969	.01670	0E-7	.00125187
DFBETA for EXPSR(1)	10176	-.00731	.00529	0E-7	.00086911
DFBETA for REFUSE(1)	10176	-.06702	.05837	0E-7	.00332322
DFBETA for REFUSE(2)	10176	-.06631	.05894	0E-7	.00314446
Valid N (listwise)	10176				

APPENDIX B: Scatter Plots for Diagnostic Checking for Standard Logistic Model



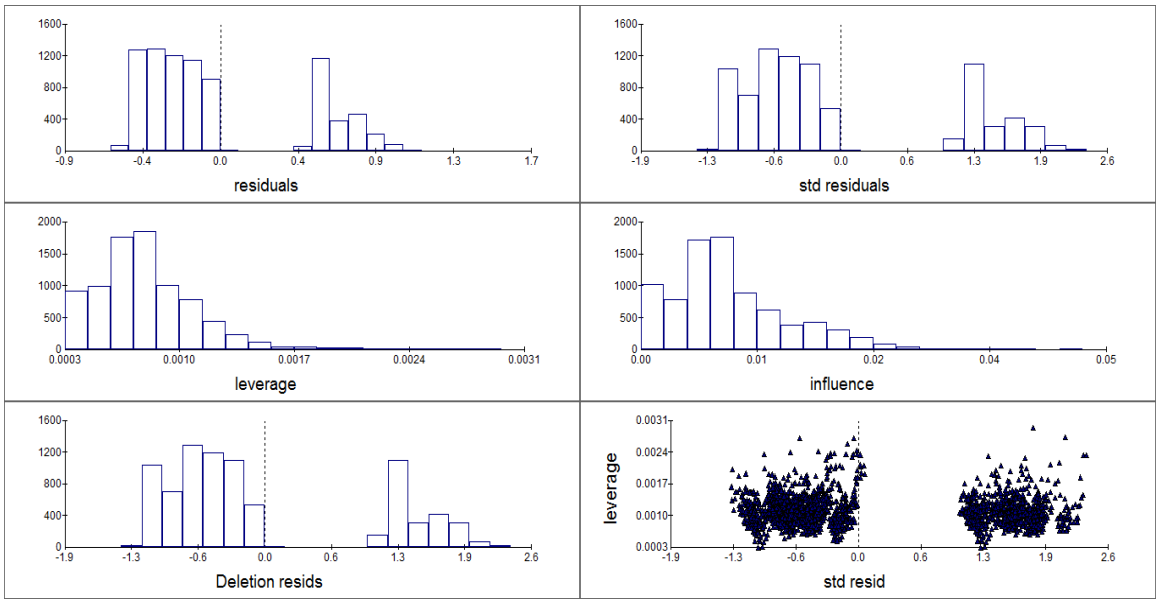






Appendix C: Diagnostic Checking for the Multilevel Model

1. Residual Plots for Level-One



2. Residual Plots for Level-Two