DETERMINANTS OF CONTRACEPTIVE USE AMONG MARRIED WOMEN IN ETHIOPIA: ORDINARY LOGISTIC AND MULTILEVEL LOGISTIC REGRESSION ANALYSES

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This is to certify that the thesis prepared by Eskezeia Yihunie, entitled: Determinants of contraceptive use among married women in Ethiopia: Ordinary Logistic and Multilevel Logistic Regression Analyses and submitted in Partial fulfillment of the requirements for the Degree of Master of Science in Statistics (Biostatistics) complies with requirements of the university and meets the accepted standards with respect to originality and quality.

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Abstract

Determinants of contraceptive use among married women in Ethiopia: Ordinary Logistic and Multilevel Logistic Regression Analysis

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Ethiopia is one of the sub-Saharan African countries with alarming population growth rate (2.6%) and high total fertility rate. To reduce high population growth and high fertility in Ethiopia, the contraceptive use status of women needs to be increased. The main objective of this study was to examine the determinants of contraceptive use and to examine how socio-economic, demographic and other proximate factors measured at different levels of a multilevel structure affect contraceptive use. The EDHS 2011 data have a two-level hierarchical structure, with 9,324 married women nested within eleven regions. The ordinary logistic regression and multilevel logistic regression model analysis were used to identify determinants of contraceptive use. The results of the ordinary logistic regression revealed that place of residence, woman education level, age group, religion, exposure to mass media, visited by family planning workers, desire for more children, knowledge about family planning methods, education of partners and both occupation of women and their husbands/partners were important determinants of contraceptive use. Multilevel logistic regression analysis was employed to examine regional variations. The random intercept model revealed that there was a significant variation in contraceptives use across regions. The results of random intercept with fixed slope model showed that contraceptive use in Affar and Somali regions were below the average for all regions while Addis Ababa and Amhara have better performance than the average. The Random coefficient model was used to investigate whether individual level covariates vary across regions. The results showed that contraceptive use varied across regions, and regional level random effects of mass media exposure (radio, TV and newspapers) and religion were found to be significant in explaining variations for contraceptive use across regions of Ethiopia. As a result special attention needs to be paid, in particular, to the regions while formulating family planning policies in Ethiopia, for better success rate of family planning intervention programs.

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List of Acronym

AIC/BIC	Akaike/Bayesian Information Criterion
A/OR	Adjusted/ Odds Ratio
CCU	Current Contraceptive Use
CPR	Contraceptive Prevalence Rate
CSA	Central Statistical Agency
EAs	Enumeration Areas
E/DHS	Ethiopian/ Demographic and Health Survey
FGAE	Family Guidance Association of Ethiopia
FHD	Family Health Department
FP	Family Planning
HIV/AIDS	Human Immune Virus /Acquired Immune Deficiency Syndrome
ICC	Intra Class Correlation Coefficient
MCH	Maternal and Child Health
MDGs	Millennium Development Goals
MOH	Ministry Of Health
NGO	Non Governmental Organizations
PQL/MQL	Penalized/Marginal Quasi Likelihood
PSU	Primary Sampling Unit
RIGLS /IGLS	Reweighted /Iterative Generalized Least Squares
SNNPR	Southern Nations Nationalities and Peoples Region
SPSS	Statistical Package for Social Science
SSA	Sub-Saharan Africa
TFR	Total Fertility Rate
TGOE	Transitional Government of Ethiopia
UNDP	United Nations Development Program
UNICEF	United Nation Children‟s Fund
USAID	United States Agency for International Development
WHR	World Health Report

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Fertility is highest among sub-Saharan African countries at an average of 5.3 children per woman. Ethiopia is one of the sub-Saharan African countries with alarming population growth rate (2.6%) and the total fertility rate or the number of children a woman will have at the end of her reproductive age approximate 5 (MOFED, 2010; EDHS 2011and IPCFCP, 2003).

Experience over the last couple of decades in Ethiopia has shown that as the human population increases, the population carrying capacity of the environment decreases. A high population growth induces increased demand for resources and the rate at which these resources are exploited. As a step towards addressing population problems Ethiopia developed its own population policy. The objectives of the policy stated were: reducing the total fertility rate per woman to 4.0, by the year 2015, and increasing the contraceptive prevalence to 44% by the year 2015. The policy also outlined that a strategy to address the above policy objectives is through expanding health institutions and community based contraceptive distribution services by mobilizing public and private resources, Transitional Government of Ethiopia (TGOE, 1993). Moreover, the five year Growth and Transformation Plan (2011-2015) for Federal Government of Ethiopia has set bold targets to the achievement of MDGs in health sectors through expanding health extension programs to increase access to preventive and promotive health services, including quality family planning services at the community and household levels (Kesetebirhan, 2011).

To reduce population growth, family planning programmes have been in place for more than thirty years in many regions of the world. It is agreed that increased family planning expenditures are an effective long-term investment in human capital development and family welfare. Contraceptives prevent maternal deaths by reducing the number of times women go through pregnancy and childbirth. They also provide significant protection for women by preventing unintended pregnancies, which often end in unsafe abortions. These in turn can threaten the life of the mother or lead to infertility and related social stigma. Contraceptives also allow women to delay motherhood, space birth and protect themselves from sexually transmitted diseases including HIV/AIDS. In Ethiopia the concept of family planning has been promoted since 1966, by the initiation of concerned volunteers who established FGAE (Family Guidance Association of Ethiopia). In 1980 a maternal and child health (MCH) coordinating office was established as a department under MOH. After ten years of its establishment, it is recognized as FHD (Family Health Department). With four teams under it of which one is a family planning team, which was running family planning programs nationally until federalism took place and similar departments in all regions handed over the program activities (Zergu, 2003).

At present, family planning services are provided through government and NGO service outlets, including hospitals, health centers, health posts, and community based distribution and social marketing. Although the services have been provided for a prolonged time, contraceptive prevalence has not reached a level whereby it will have an impact on fertility. This was mainly attributed to the service delivery system, which was carried out through the network of general health facilities that are available mostly in urban or semi-urban communities, the bulk of the rural population remained without access to family planning services (Assefa et al, 2006).

According to Ethiopian demographic and health survey of 2000, knowledge about family planning is relatively high with 86% of currently married women. However, actual contraceptive practice among women of reproductive age group remained very low (EDHS, 2000). The factors that influence contraceptive practice are multifaceted and challenging. Several studies evidently indicate that most women‟s knowledge and use of contraception is associated with socio-economic, demographic and other proximate factors (Ali et al, 2004 and Nega, 2008).

Considering the present low level of utilization of contraceptives, achieving the MDGs will be a major challenge for Ethiopia. To reach the MDGs, giving attention to the importance and benefits of lowering population growth is mandatory. There are a number of NGOs working on the reproductive health and family planning issues in support of the government policy toward family planning. But previous studies showed utilization of contraceptives was lower despite of their knowledge about it. Furthermore, married women in the reproductive age groups have lower contraceptive prevalence rate (CPR) in Ethiopia compared to unmarried sexually active ones (EDHS, 2005).

Identification of possible factors that determine the utilization of contraceptives will have greater input to program managers for designing programs, proper implementation and evaluation of their contribution with regard to family planning. In addition, it helps to initiate interventions to be designed in order to improve contraceptive utilization among currently married women in Ethiopia.

1.2 Statement of the Problem

Ethiopia is known to have high fertility, total fertility rate of approximately five children per woman and low contraceptive prevalence rate of 29 percent among currently married women of reproductive age (EDHS, 2011). To date, knowledge of contraceptive methods is high among currently married women, but the practice is not at the stage where it can significantly affect fertility trends, levels and patterns. In addition to this family planning effort to influence the level of fertility is very low in Ethiopia.

On the other hand, to reach the MDGs giving attention to the importance and benefits of lowering population growth is mandatory. It is known that fertility decline, by increasing the use of contraceptives in all levels and groups of people. Thus, family planning workers should make an effort to meet the needs of existing contraceptive users, and also to address socio-economic, demographic and other barriers for contraceptive users in the society.

The people of Ethiopia are multi-ethnic and multi-cultural. Due to the multi-ethnic and multi-cultural nature of the society, the ways of accepting contraceptive methods varies within societies (women) and across regions. Moreover, socio-economic and demographic factors on the use of contraceptive methods may cause variation at individual and regional levels.

Yet, very few studies conducted about contraceptive use among women in Ethiopia particularly about the effects of economic, demographic and socio-cultural factors aiming at identifications of individual and regional variations. Therefore, this study is an attempt to fill the research gap by identifying the socio-economic, demographic and other proximate factors of contractive use, the extent of variations and the factors that vary across regions of Ethiopia. This intern helps to improve proper use of contraceptive methods and to arrest the trend towards increased population size.

1.3 Objectives of the study

1.3.1 General objective of the study

The general objective of this study is to identify determinants of contraceptive use among married women in Ethiopia and examine variations in contraceptive use between and within regions

1.3.2 Specific objectives of the study

1. To identify socio-economic, demographic and other proximate factors that affect the use of contraceptive methods among married women in Ethiopia.
2. To examine the extent of variation in contraceptives use within and between regions of Ethiopia.
3. To identify the factors that explain the variation in contraceptive use between and within regions
4. To suggest relevant recommendations and address area of intervention.

1.4 Significance of the Study

The findings obtained from this research could be useful in many ways. Governmental and non-governmental organizations could take intervention measures and set appropriate plans to improve the existing level of awareness and use of contraceptive methods and give priority to the regions which have low and poor contraceptive use practice. The findings could also be helpful for policy making, monitoring and evaluating the activities for the government and different concerned agencies. It also helps individuals to have enough knowledge about use and practice of contraceptive methods among married women in Ethiopia.

CHAPTER TWO

LITERATURE REVIEW

2.1 Theoretical Literature

The levels and trends of contraceptive use are influential variables in fertility change, and causal inference about fertility conditions and changes. Recent studies among surveyed countries have shown that fertility is declining in most developing countries caused by the rise in the level of contraceptive use (UNICEF, 2007). The field of demographic research has identified the reasons why some couples use contraceptives and others do not, in order to space births and limit family size. In sub-Saharan Africa even though knowledge of contraception is high ranging from 60% among women with no education to 98% among women with post-secondary education, the practice (with fewer than 1% among uneducated and 22% among highly educated women) is not as much as required, (Oni and McCarthy, 1990).

Between 1990 and 1994, the global average contraceptive use by married women of reproductive ages from 15 to 49, rose from 57% to 60% (Hamilton, 1997). The introduction of combined oral contraceptive pills also brought about the sexual revolution in the West. Worldwide, however, there are still unmet needs especially in developing countries, where a scarcity of resources and information, cultural and political barriers, and societal attitudes or misconceptions, conspire to exact a heavy toll on all women health, with unwanted pregnancies, unsafe abortions, maternal mortality and HIV infection still leading causes of death of women. Even in developed countries, the situation is far from ideal and policies and provision of services vary considerably within each country. Unwanted side effects, inconvenience of the chosen method, and media scares about safety of modern contraceptives are some of the issues that limit their acceptability. Poor contraceptive use is further compounded by ignorance among users and providers of a wide range of methods available now and likely to be so in the future. Giving women reproductive autonomy through comprehensive and up-to date information about all methods is vital for successful and long-term use of contraception (Kubba and Krasner, 2000).

Birth spacing continues to be widely accepted and practiced in many African societies. Even today, one can go to remote villages throughout the continent and find women with little or no education who recognize the importance of birth spacing for the health of their children. In fact, women who fail to observe this practice in some societies may find themselves the target of scorn or ridicule by other members of the community (Caldwell and Caldwell, 1981). Although birth spacing results in a delay in pregnancy, the motivation has not been one of achieving a smaller family size. On the contrary, spacing may have arisen to enhance the probability that each child would survive through childhood and beyond. Thus, although Westerners tend to view family planning as a means of achieving a small family norm, birth spacing in Africa has been used to attain what many Africans consider the ideal large number of healthy children. Reports from the early 1980s indicated that the practice of postpartum abstinence was on the decline throughout Africa (Page and Lesthae‟ghe, 1981).

Birth control is a priority in Ethiopia and many programmes to increase contraceptive practice have been implemented by the Ethiopian National Population Policy since 1993. However, the problem of high fertility and low contraceptive practice remains unresolved. The total fertility rate of the country for the year 2000 was found to be 5.9 children per woman and the contraceptive prevalence was only 8%. This is too low to affect the fertility levels significantly (EDHS 2000), and the fertility rate of the country actually increased to 6.1 children per woman for the year 2003 (WHR 2005). High population growth prevents the long term socio-economic development needed to alleviate poverty and to meet the immediate basic needs of the rapidly increasing population (Bandura 2002; Merrick 2002). Accurate and specific data about the reason behind the low contraceptive practice in a country should be available in order to develop an effective and relevant family planning strategy.

2.2. Empirical Literature

2.2.1 Demographic factors

Different studies indicate that demographic variables have been identified to influence contraceptive use. Among these variables, age of women, number of living children and desired family size are the most important ones.

Number of living children: The number of living children in the family seems to influence the tendency of contraceptive use. Studies have shown that use of contraceptive methods increases with parity of woman up to the third or fourth child and then declines which results in an inverted U shaped pattern (Mamadani et al, 1993). This is partly because, many women have a desire to space births at early reproductive age and seek to stop after the desired family size has been achieved. Zewudu et al (2003) argue that women who had achieved or exceeded their ideal family size were about twice as likely to be current users as were women who had not yet reached their ideal number. In addition to this large number of living children encourages married woman to space or limit the fertility. That means the likelihood of wanting no more children increases with the actual number of living children. Omwago and Khasakhala (2006) in their study indicated that couples who have more children are more likely to have unmet need than the ones who have fewer children or none at all.

The analysis of multilevel logistic regression on modern contraceptive use and contraceptive method choice employed to investigate the relationship between socio-demographic and programmatic factors using data from the Indonesia Demographic and Health Survey of 1997 used a total of 24,999 currently married and non-pregnant women in the study. The result of this study indicated that number of living children was an important factor to determine modern contraceptive use. In addition to this, demographic characteristics of women such as age, ideal number of children, are important factors to determine modern contraceptive use (Gunawan, 2002).

The results of a study was done by Abdurrahman (2011) on prevalence and determinants of modern contraceptive methods utilization among married women of reproductive age group in Debre Birhan District, Ethiopia using the logistic regression method showed that those women who had one or more children were practicing modern contraceptives more than those women who have no children. Those women who had more than 5 children were almost 3 times less likely to use modern contraceptives than those women who did not have children.

Age of women: In most countries contraceptive use prevalence is lowest among young women, reaches a peak among women in their thirties and declines among older women (Robey et al 1992; EDHS, 2005). This may reflect a high desire for child bearing among young women, and a high growing interest of spacing births among women in their thirties. Percentage of users declines at older ages of reproduction; probably this may be because they are not at a risk of pregnancy.

A cross sectional study of 288 females selected through consecutive sampling was conducted in Jinnah Post graduate Medical Center family reproductive health care center Karachi, Pakistan from November 2008 to January 2009. Females of reproductive age 16–50 years using any contraceptive measures with the objectives of identifying contraceptive methods and factors associated with modern contraceptive in use were considered. The results showed that the mean age of contraceptive users was 29.49 (±6.42) years. Results using logistic regression showed that age above 30 years [AOR, 0.426 95% CI 0.209–0.865] has influence on usage rate (Hammad et al, 2010).

A study was done by Curtis and Blanc (1997) showed that women‟s age has an effect on contraceptive failure rate, the likelihood of which declines with increasing age. They examined contraceptive failure in six countries; the contraceptive failure rate of women in the age group 35-49 was lower than that in the younger age groups (below 25 years and 25-34 years). Trussell and Kost (1987) stated that contraceptive failure is more prevalent among younger women because, in addition to being at a young and productive age, they tend to have less motivation for using contraception consistently whereas with the rise productiveness lowers which ultimately tends to reduce exposure to the risk of pregnancy risk.

2.2.2 Socio-economic Factors

Education level of women: Educated women are more likely to know about contraceptive methods and to be more confident in approaching service providers than women with no education. Education helps to have better access to family planning services.

A quantitative study using a descriptive survey design was conducted in Jimma University hospital, to identify awareness and determinants of family planning practice in Jimma, Ethiopia. The results revealed that current contraceptive practice was significantly associated with women‟s level of education (χ^2 =39.722, p =0.000) (Beekle and McCabe, 2006). A lack of formal education for women was identified as a key factor in preventing change in the patterns of contraceptive knowledge and use by women in this part of Ethiopia. The findings also revealed that the knowledge and practice of modern contraception methods was low. Most women's contraceptive knowledge and practice was influenced by socio-cultural norms such as male/husband dominance and opposition to contraception, and low social status of women. A study aimed to investigate contraceptive use and its determinants in Kocaeli, Turkey, concluded that increasing the education level of couples and the status of women would result in increased contraceptive use. Since the contraceptive use behavior of women is influenced by their husbands' attitudes, family planning programs should be focused on the needs of both partners (Vural et al, 1999). Most women are likely to see the benefit of their children schooling; they may develop higher aspirations for their own children"s schooling. It is obvious that as the number of children increases, familial resources available to an individual child decrease. Restricting the number of children is the best solution in order to have better-educated children and more familial resources per child. It would be advantageous for a woman to have fewer children that she can afford to pay for the tuition and other related fees associated with schooling, hence the trade-off between quality and quantity of children (Ainsworth et al. 1996).

Another study conducted in Kenya has shown that unmet need among couples seemed to decline with increasing education (Omwago and Khasakhala, 2006). This study showed that couple who are more educated can afford to buy contraceptives, are more likely to reside in the urban areas where contraceptives are more accessible, are more informed about the available methods and are more likely to prefer small families than their less educated counterparts. As a result, those with no education had the greatest unmet need.

The Ethiopian 2005 DHS showed that the contraceptive prevalence rate increased with educational attainment. It increased from 10% among women with no education to 53% among those with secondary and higher education. The same study revealed that women with no education were twice more likely to have unmet need for contraception than women with secondary and higher level of education (EDHS, 2005). In elaborating the issue (World Bank, 2007) added that on average women with primary education were 3.6% more likely to use contraceptives than women with no education; while women with more than primary education were 5.4% more likely to use contraceptives.

Place of residence: The observed variation, in the practice of contraception, may be attributed to differences in the availability of social services such as, education information about method and access to family planning and health care services which are among the important ones. In Ethiopia, for instance, 69% of females in urban areas and 27% of the females in rural areas had some education. And women in urban areas were three times more likely to have heard of family planning messages on the radio than in those in rural areas (EDHS, 2005). Unmet need was even higher in rural areas (37%) compared to urban areas (22%). This can be explained by a relatively a high failure on the supply side of rural areas in meeting the demand for family planning compared to urban areas (World Bank, 2007). Urban women are more likely to use modern methods than rural women because of greater access to modern methods in urban areas (Bertrand et al., 1993). In general, the difference in the availability of social services in place of residence influences the use of contraception differently.

Mass media exposure: Exposure to mass media is an effective way towards contraceptive behavior. By diffusing information, it will effect changes in attitudes and practice of contraception although this differs in a variety of populations (Bertrand et al, 1987; Rutherford and Mishra, 1997; Kane et al, 1998). Using the traditional theater, and music, which broadcast on radio and television in Mali, Kane (1998) found that contraceptive use was associated with intensity of mass media exposure. Another study was done by Dunn (2001) based on a micro demographic community study in northeastern Brazil to determine whether exposure to mass media early in the life course is linked to higher rates of contraceptive adoption and lower numbers of births at specified ages.

A study was done about the socio-economic determinants of contraceptive use among rural women in Ikwuano Local Government Area of Abia State, Nigeria. It examined the socio economic determinants of contraceptive use among rural women by Okezie et al (2010). The results of the study strongly suggested that mass media messages had a powerful effect on modern contraceptive use; exposure to mass media messages resulted in greater likelihood of use of modern contraception; education had a positive effect in explaining women‟s current use of contraceptives; educated women were more likely to appreciate the advantages of having fewer, better educated children.

Dwivedi and Sundaram (2000) examined epidemiological models and related simulation results for understanding of contraceptive adoption in India using data from an Indian State, Uttar Pradesh (UP), collected by the National Family Health Survey (NFHS). Two-level logistic regression analysis was carried out for which women's level (level 1) and Primary Sampling Unit level (level 2) variables were considered. Results of the study revealed that those more likely to adopt contraception were women exposed to a TV message (OR= 1.3; 95% CI: 1.1–1.6). Furthermore, the study revealed that for women who were educated to high school level and above OR = 2.9 (95% CI: 2.2–3.7); for those whose husbands were literate with schooling of 11 or more years OR = 1.7 (95% CI: 1.4–2.1); and who had 2 or more living sons OR = 2.2 (95% CI: 1.1–4.4).

In relation to Ethiopia a study showed that women who are exposed to the broadcast or the newspaper had better knowledge about family planning compared with women who had no media exposure at all. The study used bivariate and multivariate analysis and the findings showed that education contributes significantly to the quality of women‟s lives in that improving women‟s access to education and encouraging continuous and constant exposure would significantly increase use of family planning and reduce unmet need. Moreover, women with media exposure were about four times as likely to use a method of family planning as compared to women with no media exposure. The study concluded that media exposure had a profound effect on contraceptive use (Antennae, 2002).

Religion: The strength of one‟s religiosity or degree of one‟s adherence to the norms of a given religion may exert an influence on ones‟ mode of life including reproductive behavior. Studies in developing countries revealed that social, cultural and religious unacceptability of contraception frequently emerged as an obstacle to use contraception (Vassoff, 1990; Oni and McCarthy, 1990; Caldwell and Caldwell, 1987). Vassoff (1990), in his study about family planning in rural Sri Lanka, for instance has claimed that a women‟s worth is measured in terms of her children. Oni showed that high fertility norms are thought to be deeply rooted in African societies. Consequently, family planning programs and substantial increase in contraceptive prevalence are not bright. In this regard, societal and parental influences are also factors to be considered in the study of fertility in general and contraception in particular.

Work status: The work status of women has also something to do with the adoption of contraceptives. Working women, particularly, those who earn cash incomes have greater control over household decisions, increased awareness of the world outside home. Consequently, they have more control over reproductive decisions (Assefa et al, 1999). The study showed that paid work also provided alternative satisfactions for women and rearing children and may promote contraceptive use.

Furthermore, a study in Sri Lanka indicated that couples work status had a moderate effect on contraceptive use. Couples, where husbands had non-farm employment and the wives work outside home, had higher rate of use than couples with husbands who worked as farmers and the wives do not work outside home (Rutherford et al, 1989). This enhanced family planning, which in turn influenced contraception use increase. Evidences have always shown that women when employed outside home would get informed and are more likely to assume opportunity costs in rearing children than their counterparts employed at home. In addition to this, as children become more and more expensive the strong desire for more children changes (Assefa et al 2007). This can also serve as an outlet to adopt contraception. A study in Zaire also revealed that women who were employed had significantly higher chances of using any form of contraceptive methods than those who were not employed (Shapiro and Tambashe, 1994). The study showed that women who worked outside home and earned cash income had more control over reproductive behavior. Women who worked outside home with cash payment were likely to use contraceptive compared to those who did not work out side of home (Rahman, 2000).

Economic status of household: Wealth index is one indicator of the household‟s socioeconomic status. It uses data for household ownership of consumer goods; characteristics of the dwelling; sources of drinking water; toilet facilities and others features. Indonesian‟s women with a higher level of the wealth index or higher socioeconomic level were high in contraception use (Shoemaker, 2005). However, that study reported that wealth is less important than others variables, such as the desired number of children in determining the current use of contraception.

It also showed that neither wealth nor socioeconomic status could be assumed as the dominant factor to influences contraceptive use in Indonesia.

2.2.3 Other proximate factors towards contraceptive use

Knowledge of contraception: Lack of knowledge is an important cause for non-use. Women are considered to have acceptable knowledge of method if they know whether they have ever heard of a method that a couple can use to delay or avoid pregnancy. But this does not imply that the respondents‟‟ knowledge about contraceptive use, its main side effects, and where it can be obtained. A study was done on ethnic disparities in contraceptive use and its impact on family planning program in Nepal. Results of multilevel logistic regression showed that exposure of women to family planning messages through health facilities, family planning workers, and means of communication, increased the use of modern contraceptives. However, impact of the family planning information on contraceptive use varied among ethnicity. In addition to this women who were exposed to family planning information from radio were more likely to use modern contraceptives than women not exposed to radio information (OR=1.22, P< 0.01)(Mishra ,2011).

Women who had been visited by a family planning worker at home and women who visited a health facility and discussed family planning were twice as likely to use contraceptives as women who had not been visited by a family planning fieldworker or women who visited a health facility but did not discuss family planning. Nine in ten women who have had no contact with a family planning worker at home and who did not visit a health facility were not able to satisfy their demand for family planning (Antenene, 2002).

Binyam et al (2011) used multivariate logistic regression model to determine married women"s decision making power about modern contraceptive use in urban and rural southern Ethiopia. The result showed that having better knowledge about modern contraceptive methods was a statistically significant factor for better decision making power of women on the use of modern contraceptive methods in the rural part [OR: 6.8, 95% CI 3.28,13.91].

Husbands' approval is also of paramount importance in the adoption of contraceptive use. A study in Nigeria also found that spousal communication about contraception and approval of a contraceptive method were found to have significant impact on everuse of modern contraceptives (Oyedokun, 2007). Another study was done in Mareka woreda, Dawro zone, Ethiopia to assess determinants of modern contraceptive use. Logistic regression analysis revealed that respondents who responded that both husband and wife decided on contraceptive use together was found statistically significant [OR= 2.29 95% CI 1.25, 4.20, p. value=0.008] (Tilahun, 2005).

CHAPTER THREE

DATA AND METHODOLOGY

3.1 Source of Data

The source of data for this study was the 2011 Ethiopia Demographic and Health Survey (EDHS 2011) which is obtained from Central Statistical Agency. It is the third comprehensive survey designed to provide estimates for the health and demographic variables of interest for the following domains: Ethiopia as a whole, urban and rural areas (or all nine regions and two administrative cities) of Ethiopia. The survey was primarily designed to collect data on marriage, fertility, family planning, maternal and child health, HIV/AIDS, malaria, nutrition and gender. In relation to this women of reproductive age (15-49) are the main focus of this survey. The DHSs are typically conducted every five years and usually based on a large sample.

EDHS employed a two stage sampling. In the first stage, 540 clusters (145 urban and 395 rural) were selected from the list of enumeration areas (EAs) of the 1994 Population and Housing Census sample frame. In the second stage, a complete household listing was prepared for each selected cluster and households. Households were systematically selected from each cluster for participation in the survey.

The 2011 EDHS collected information from a nationally representative sample of 16,515 women aged 15-49 years out of which 9,324 married women aged 15-49 included in the study.

3.2 Variables considered in the study

3.2.1 The response variable

The outcome of interest in this study is status for the use of contraceptive methods. Contraceptive methods considered here cover modern, traditional and folkloric methods of contraception. Among the methods, „**modern method**" included methods like Pill, IUD, Injectables, condom, LAM etc; „**traditional method**" included periodic abstinence, withdrawal etc and while „**folkloric method**" included use of herbs etc. For the purpose of our study the response variable „using any contraceptive methods for woman is recoded as follows: those women who were using any one of the contraceptive methods are coded as 1 and those who were not using any contraceptive methods are coded as 0. Hence, the response variable for the i^{th} woman is represented by a random variable Y_i with two possible values coded as 1 and 0. That is

$$Y_i = \begin{cases} 1, & \text{if the } i^{th} \text{ woman used any contraceptive method.} \\ 0 & \text{Otherwise.} \end{cases}$$

3.2.2 Predictor/explanatory variables

Several variables that are associated with contraceptive use as suggested by the in the literature were included as predictor variables. These include age of women, number of living children, education level of women, religion of women, place of residence, region, occupation of women, husband/partner"s education level, and current marital status, knowledge about FP method, visited by FP worker during the last 12 months before the survey, and exposure to any mass media.

Table 3.1 Description of the variables and coding

The descriptions of the socioeconomic, demographic and other proximate factors for the status of usage of contraceptive methods are presented below.

Variables and representation of variables	**Categories**
1.Age of woman (age)	1=15-19 2=20-24 3=25-29 4=30-34 5=35-39 6=40-44 7=45-49
2.Religion (religion)	1=Others 2= Coptic orthodox 3=Protestant 4=Muslim
3.Woman educational level (educa)	1=no education 2=primary 3=secondary and higher
4.Partner‟s/husband's education level (heduca)	1=no education 2=primary 3=secondary and higher
5.Place of residence (resid)	1=urban 2=rural
6.Region (region)	1=Tigray 2=Afar 3=Amhara

	4=Oromiya 5=Somali 6=Ben-Gumuz 7=SNNP 8=Gambela 9=Hareri 10=Addis Ababa 11=Dire Dawa
7.Knowledge of a woman about FP method (kfpmethod)	0=No 1=Yes
8.Visited by family planning worker during last 12 months (visitedfp)	0=No 1=Yes
9.Exposure to any mass media (media)	0=No 1=Yes
10.Husband"s/partner"s occupation (hoccup)	1= not working 1= agricultural sector 2=non agriculture sector
11.Number of living children (Numchild)	0 =no children 1=1 or 2 children 2= 3 or more children
12. woman"s occupation (woccup)	1=not working 2=agricultural sector 3=non agricultural sector
13. desire for more children (dmch)	0=wants more children 1= Does not want more children

3.3 Methodology

3.3.1 Logistic regression

Logistic regression is a popular modeling approach when the dependent variable is dichotomous or polytomous. This model allows one to predict outcomes, from a set of variables that may be continuous, discrete, dichotomous, or a mix of any of these (Hosmer and Lemeshow, 2000).

Logistic model, as compared to its competitor, the probit model, is less sensitive to outliers and easy to correct a bias (Copas, 1988). In instances where the independent variables are categorical or a mix of continuous and categorical, logistic analysis is preferred to discriminant analysis (Agresti, 1996). The assumptions required for statistical tests in logistic regression are far less restrictive than those for ordinary least squares regression. There is no formal requirement for multivariate normality, homoscedasticity, or linearity of the independent variables within each category of the response variable. 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, low error in the explanatory variables, no outliers and sampling adequacy.

The relationship between the predictor and response variables is not a linear function in logistic regression; instead, the logistic regression function, which is the logit transformation of the success probability, is used. Consider a collection of k explanatory variables denoted by the vector $X' = (X_1, X_2, \ldots, X_k)$. Let the conditional probability that the outcome is present be denoted by $P(Y = 1|X) = p$.

$$p = \frac{\exp\left(\beta_o + \beta_1 X_1 + \ldots + \beta_k X_k\right)}{1 + \exp\left(\beta_o + \beta_1 X_1 + \ldots + \beta_k X_k\right)} \tag{3.1}$$

Then the logit or log-odds of having Y=1 is modeled as a linear function of the explanatory variables as:

$$\log\left(\frac{p}{1-p}\right) = \beta_o + \beta_1 X_1 + ... + \beta_k X_k; 0 \le p \le 1 \ , \tag{3.2}$$

where β_0 is a constant of the equation and, $\beta_1,\ldots,\beta_k$ are the coefficients of the predictor variables. The estimated logistic coefficient β_j „s are interpreted as the change in the log-odds for every unit increase/decrease (depending on the variable change in x_i) holding other predictors constant (Agresti, 1996).

The odds ratio is defined as the ratio of the probability that the event will occur to the probability that the event will not occur. That is, the odds of the event E (in this case the odds of currently using contraceptive methods, Y_i =1) is given by

$$Odds(E) = \frac{P(E)}{P(notE)} = \frac{P(E)}{1-P(E)} \tag{3.3}$$

With further rearrangement, the odds of using current contraceptive methods can be expressed as:

$Odds(y_i = 1) = \frac{p}{1-p} = \exp(x`\beta)$; where p is the probability of success.

3.3.1.1 Estimation of logistic regression parameters

The most commonly used method of estimating the parameters of a logistic regression model is the method of Maximum Likelihood (ML). In logistic regression, the likelihood equations are non-linear explicit functions of the unknown parameters. Therefore, we use a very effective and well known as the Newton-Raphson iterative method also known as iteratively reweighted least squares algorithm to solve the equations (Hosmer and Lemeshow, 2000).

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

$$g(y_1, y_2, \ldots, y_n) = \prod_{i=1}^{n} p_i^{y_i}(1-p_i)^{1-y_i} \tag{3.4}$$

the log-likelihood function as:

$$L(\beta_o, \beta_1, \ldots \beta_k) = \sum_{i=1}^{n} y_i(\beta_o + \beta_1 X_1 + \ldots + \beta_k X_k) - \sum_{i=1}^{n} \ln\{1 + \exp(\beta_o + \beta_1 X_1 + \ldots + \beta_k X_k)\} \tag{3.5}$$

The most effective and well known Newton-Raphson iterative method can solve the equations and the estimated coefficients are denoted by $\hat{\beta}_0, \hat{\beta}_1 \ldots, \hat{\beta}_k$.

3.3.1.2 Test of overall Model fit

3.3.1.2.1 The Hosmer-Lemeshow Test

The Hosmer-Lemeshow test is used to check the overall model fit. In this approach, data are divided into g (usually10) groups. From each group, the observed and expected number of events will be computed. Then, the Hosmer-Lemeshow test statistic is given by

$$\hat{C} = \frac{\sum_{j}^{g}(O_j - E_j)^2}{V_j} \tag{3.6}$$

where $E_j = np_j, V_j = np_j(1-p_j)$, g is the number of group, O_j is observed number of events in the j^{th} group, E_j is expected number of events in the j^{th} group, and V_j is a variance correction factor for the j^{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 that the model is adequate to fit the data. This statistic has an approximate chi-square distribution with (*g*-2) degrees of freedom (Agresti, 1996).

If the calculated p-value of the Hosmer-Lemeshow goodness-of-fit test statistic is greater than 0.05, we will not reject the null hypothesis that there is no difference between observed and model-predicted values, implying that the model estimates are adequate to fit the data at an acceptable level.

3.3.1.2.2 The likelihood ratio test

The likelihood ratio (LR) test is performed by estimating two models and comparing the fit of one model to the fit of the other. Removing predictor variables from a model will almost always make the model fit worse (i.e., a model will have a lower log likelihood), but it is necessary to test whether the observed difference in model fit is statistically significant. The likelihood ratio test does this by comparing the log likelihoods of the two models. 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. If one has the log likelihoods from the models, the likelihood ratio statistic is fairly easy to calculate. The likelihood ratio test is performed to test the overall significance of all coefficients in the model on the basis of the test statistic: $G^2 = [(-2\ln L_o)-(-2\ln L_1)]$, where, L_0 is the likelihood of the null model and L_1 is the likelihood of the saturated model. The statistic G^2 plays the same role in logistic regression as the numerator of the partial F-test does in linear regression.

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).

3.3.1.3 Tests of a single predictor

3.3.1.3.1 The Wald test

The Wald test is an alternative test which is commonly used to test the significance of the individual logistic regression coefficients for each independent variable .That is, the Wald test is used to test

H_0: β_i =0 against H_1: $\beta_i \neq 0$, i =$1,\ldots, k$

For a dichotomous independent variable, the Wald statistic (W) is

$$W = \left[\frac{\hat{\beta}_i}{SE\left(\hat{\beta}_i\right)} \right]^2 \qquad , i=1,...,k \qquad (3.7)$$

For large sample size this statistic has an approximate chi-square distribution with one degree of freedom.

3.3.1.3 Model Diagnostics: Influential observations and Outliers

Cook's distance is a measure of the influence of a case. Cook"s distance less than unity shows that an observation had no overall impact on the estimated vector of regression coefficients β.

DFBETA(S) is a diagnostic measure which measures the change in the logit coefficients for a given variable when a case is dropped. If DFBETAs is less than unity, this implies no specific impact of an observation on the coefficient of a particular predictor variable, while DFBETA of a case greater than 1.0, and implies the observation is an outlier (Cook and Weisberg, 1982).

3.3.2 Review Multilevel Modeling

In multilevel research, the structure of data in the population is hierarchical, and a sample from such a population can be viewed as a multistage sample. Because of cost, time and efficiency considerations, stratified multistage samples are the norm for sociological and demographic surveys. For such samples the clustering of the data is, in the phase of data analysis and data reporting, a nuisance which should be taken into consideration. However, these samples, while efficient for estimation of the descriptive population quantities, pose many challenges for model-based statistical inference (Khan and Shaw, 2011).

Cluster sampling scheme often introduces multilevel dependency or correlation among the observations that can have implications for model parameter estimates. For multistage clustered samples, the dependence among observations often comes from several levels of the hierarchy. The problem of dependencies between individual observations also occurs in survey research, where the sample is not taken randomly but cluster sampling from geographical areas is used instead. In this case, the use of single-level statistical models is not reasonable. Hence, in order to draw appropriate inferences and conclusions from multistage stratified clustered survey data, we may require complicated modeling techniques like multilevel modeling. Multilevel models contain variables measured at different levels of the hierarchy.

The 2011 EDHS data set used for this study is based on a multistage stratified cluster sampling. The appropriate approach to analyzing contraceptive data from this survey is therefore based on nested sources of variability. Here the units at lower level are individuals (married women aged 10−49) who are nested within units at higher level (regions). Due to this nested structure, the odds of women experiencing the outcome of interest are not independent, because women from the same cluster (region) may share common exposure to community characteristics. The response variable in this study is “using contraceptives” which is binary and hence multilevel logistic regression model is a natural choice for modeling. The multilevel logistic regression analysis considers the variations due to hierarchy structure in the data. It allows the simultaneous examination of the effects of group level and individual level variation-independence of observations within and between groups (Khan and Shaw, 2011).

3.3.2.1 Multilevel Logistic Regression Model

We first consider a two-level model for binary outcomes with a single explanatory Variable. The extension to three or higher levels is straightforward. Let y_{ij} be the binary outcome variable, coded „0‟or „1‟, associated with level-one unit *i* nested within level two unit *j*. Also let p_{ij} be the probability that the response variable equals 1, $p_{ij} = pr(y_{ij} = 1)$. Like the ordinary logistic regression, p_{ij} is modeled using the link function, logit. The two-level logistic regression model can be given as:

$$\operatorname{logit}(p_{ij}) = \log\left[\frac{p_{ij}}{1-p_{ij}}\right] = \beta_0 + \beta_1 x_{ij} + U_{0j} \tag{3.8}$$

where, U_j is the random effect at level 2.

Equivalently, we can split model (3.8) into two models: one for level 1 and the other for level 2.

$$\operatorname{logit}(p_{ij}) = \log\left[\frac{p_{ij}}{1-p_{ij}}\right] = \beta_{0j} + \beta_1 x_{ij} \qquad \text{[Model: level 1]}$$

And $\beta_{0j} = \beta_0 + U_{0j}$ [model: level 2]

The intercept consists of two terms: a fixed component (β_0) and a group-specific component, random effect, U_{0j} .we assumes that the U_{0j} follow a normal distribution with mean zero and variance σ_{u0}^2 (Snijders and Bosker, 1999).

3.3.2.1.1 Testing heterogeneous Proportionality

For the proper application of multilevel analysis the first logical step is to test heterogeneity of proportions between groups. Two commonly used test statistics that are used to check for heterogeneity are described below.

To test whether there are indeed systematic differences between groups, the well-known chi-square test for contingency table can be used. In this case the chi-square test statistic is:

$$x^2=\sum_{j-1}^{N} n_j \frac{(\hat{p}_j-\hat{p}.)}{\hat{p}.(1-\hat{p}.)}. \tag{3.9}$$

This statistic follows approximately chi-square distribution with N-1 degrees of freedom. The approximation is valid if the expected numbers of success and of failures in each group, $n_j\hat{p}_j$ and $n_j(1-\hat{p}_j)$, respectively, are at least 1 while 80 percent of them are at least 5 (Agresti, 1996). 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).

A second test of heterogeneity of proportions was proposed by Commenges and Jacqmin

(1994).The proposed test statistic is

$$Z=\frac{\sum_{j=1}^{N}\{n_j^2(n_j\hat{p}_j-\hat{p}.)^2\}-M\hat{p}.(1-\hat{p}.)}{\hat{p}.(1-\hat{p}.)\sqrt{2\sum_{j=1}^{N}n_j(n_j-1)}} \tag{3.10}$$

The statistic, Z, follows a standard normal distribution for large values of M. Thus, large calculated values of this statistic are indication of heterogeneous proportions. In the statistic Z the numerator contains a weight of n_j^2 while chi-square test uses a weight of 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 lead to different outcomes. The test statistic Z is shown to have high power over the chi-square test and it can be applied whenever there are many groups, even with small group sizes, provided that no single group dominates. A rule of thumb for the application of this test is that there should be at least N=10 groups, the biggest group should not have a relative larger than $\frac{n_j}{M}$ = 0.10 and the ratio of the largest group size to the 10th largest group size should not be more than 10 (Snijders and Bosker, 1999).

3.3.2.1.2 Estimation of between- and within- groups variance

Consider a population having two-levels. The basic data structure of two-level logistic regression is a collection of N groups (units at level-two (regions)) and within region *j* (*j*=1, 2,…, N) a random sample of n_j level-one (women) units. The outcome variable is dichotomous and denoted by Y_{ij} (*i*=1,2,…,n_j , *j*=1,2,…,N) for level-one unit *i* in group *j*. The outcomes are supposed to be coded 0 and 1: 0 for „failure", 1 for „success" or vice versa. The total sample size is $M=\sum_{j=1}^{N} n_j$. If one does not take explanatory variables into account, the probability of success is assumed constant in each group. Let the success probability in group j be denoted by p_j. The dichotomous outcome variable for the individual *i* in group *j*, Y_{ij}; which is either 0 or 1 can be expressed as the sum of the probability in group *j*, p_j (the average proportion of *j* levels in group *j*, E (y_{ij}) = p_{ij}) plus some individual-dependent residual ε_{ij} that is, Y_{ij}= $P_j + \varepsilon_{ij}$; The residual term is assumed to have mean zero and variance, $\text{var}(\varepsilon_{ij}) = p_j(1-p_j)$.

Since the outcome variable is coded 0 and 1, the group sample average is the proportion of successes in group j given by $\hat{p}_j = \frac{1}{n_j}\sum_{i}^{n_j} y_{ij}$. (3.11) where $\hat{p}_j$ is an estimate for the group-dependent probability p_j. Similarly, the overall sample average is the overall proportion of successes, $\hat{p}_{j.}$ and is given by:

$$\hat{p}_{.} = \frac{1}{M} \sum_{j=1}^{N} \sum_{i=1}^{n_j} Y_{ij} \ . \tag{3.12}$$

This is an estimate for the overall probability of success, p. An estimator of the variance of p_j can be obtained by using

$$\hat{\tau}^2 = S^2_{between} - \frac{S^2_{wthin}}{\tilde{n}} \tag{3.13}$$

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

Between- groups variance:

$$S^2_{between} = \frac{\hat{p}(1-\hat{p})}{\tilde{n}(N-1)} \chi^2,$$ *Where* χ^2 is as given by equation (3.9), *and*

Within-groups variance**:**

$$S^2_{with} = \frac{1}{M-N} \sum n_j p_j (1-p_j).$$

3.3.2.1.3 The Empty Logistic Regression Model

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

$$f(p_i)=\beta_0+U_{0j} \tag{3.14}$$

where, β_0 is the population average of the transformed probabilities and U_{0j} the random deviation from this average for group *j*. If $f(p)$ is the log*it* function, then $f(p_j)$ is just the log-odds for group *j*. Thus, for the log*it* link function, the log-odds have a normal distribution in the population of groups, and is given by:

$$\log it(p_j)=\beta_0+U_{0j} \tag{3.15}$$

This model does not include a separate parameter for the level-one variance. This is because the level-one residual variance of the dichotomous outcome variable follows directly from the success probability, as indicated by equation $\text{var}(\varepsilon_{ij})=p_j(1-p_j)$. The probability corresponding to the average value β_0, denoted by π_0, is defined by $f(\pi_0)=\beta_0$.

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

$$\pi_0 = \operatorname{logit}(\beta_0) = \frac{\exp(\beta_0)}{1+\exp(\beta_0)} \quad \text{(Snijders and Bosker, 1999).} \tag{3.16}$$

3.3.2.1.4 The Random Intercept Logistic Regression Model

In the random intercept logistic regression model the intercept is the only random effect meaning that the groups (regions) differ with respect to the average value of the response variable. But the relation between explanatory and response variables can differ between groups (regions) in more ways.

The random intercept model expresses the log*it* of P_{ij} *as* a sum of a linear function of the explanatory variables. That is,

$$\begin{aligned} \operatorname{logit}(p_{ij}) = \log\left(\frac{p_{ij}}{1-p_{ij}}\right) &= \beta_{0j} + \beta_1 x_{1ij} + \beta_2 x_{2ij} \ldots + \beta_k x_{kij} \\ &= \beta_{0j} + \sum_{h=1}^{k} \beta_h x_{hij} \\ &= \beta_0 + \sum_{h=1}^{k} \beta_h x_{hij} + U_{0j} \end{aligned} \tag{3.17}$$

where the intercept term β_{0j} is assumed to vary randomly and is given by the sum of an average intercept β_0 and group-dependent deviations, u_{0j} .That is $\beta_{0j} = \beta_0 + U_{0j}$. The first part incorporating the regression coefficients $\beta_0 + \sum_{h=1}^{k} \beta_h x_{hij}$ is the fixed part of the model, because the coefficients are fixed. The remaining part u_{0j} is called the random part of the model. It is assumed that the residual, U_{0j} are mutually independent and normally distributed with mean zero and variance σ_0^2 (Snijders and Bosker, 1999).

As a result

$$\log it(p_{ij}) = \beta_0 + \sum_{h=1}^{k} \beta_h x_{hij} \tag{3.18}$$

Solving for p_{ij}, we obtain

$$p_{ij} = \frac{e^{\beta_0 + \sum_{h=1}^{k} \beta_h x_{hij} + U0j}}{1 + e^{\beta_0 + \sum_{h=1}^{k} \beta_h x_{hij} + U_{0j}}} \tag{3.19}$$

Thus, a unit difference between the x_h values of two individuals in the same group is associated with a difference of β_h in their log-odds, or equivalently, a ratio of exp (β_h) in their odds (Snijders and Bosker, 1999).

Random intercept models have many applications, for instance estimating the regional effects on contraceptive use, adjusting for individual women"s level factors, and within the model, evaluate and compare the performance of the region"s contraceptive use. This can be done by obtaining the odds ratio for each region. This regional effect is a measure of the performance of contraceptive use due to the region relative to the average of all regions. If the odd of contraceptive use for regional effects is sufficiently larger than one, the region is considered to have performed better than the average; if it is significantly smaller than one, the region is considered to have less performance than the expected (DeLong et al., 1997).

3.3.2.1.5 The Random Coefficient Logistic Regression Model

In logistic regression analysis, linear models are constructed for the log-odds. The multilevel analogue, random coefficient logistic regression, is based on linear models for the log-odds that include random effects for the groups or other higher level units. Consider explanatory variables which are potential explanations for the observed outcomes. Denote these variables by X_1, X_2… X_k. The values of X_h (h=1, 2… k) are indicated in the usual way by X_{hij}. Since some or all of these variables could be level-one variables, the success probability is not necessarily the same for all individuals in a given group (region). Therefore, the success probability depends on the individual as well as the group, and is denoted by P_{ij} .Now consider a model with group-specific regressions of logit of the success probability, logit (P_{ij}), on a single level-one explanatory variable X,

$$\log it(p_{ij}) = \log\left[\frac{p_{ij}}{1-p_{ij}}\right] = \beta_{0j} + \beta_{1j} x_{1ij} \tag{3.20}$$

The intercepts β_{0j} as well as the regression coefficients, or slopes, β_{1j} are group dependent. These group-dependent coefficients can be split into an average coefficient and the group dependent deviation:

$$\beta_{0j} = \beta_0 + U_{0j}$$
$$\beta_{1j} = \beta_1 + U_{1j}$$

Substitution into (3.20) leads to the model

$$\text{logit}(p_{ij}) = \log\left[\frac{p_{ij}}{1-p_{ij}}\right] = (\beta_0 + U_{0j}) + (\beta_1 + U_{1j})x_{1ij}$$

$$= \quad \beta_0 + \beta_1 x_{1ij} + U_{0j} + U_{1j} x_{1ij} \qquad (3.21)$$

There are two random group effects, the random intercept U_{0j} and the random slope U_{1j}. It is assumed that the level-two residuals U_{0j} and U_{1j} have means zero given the value of the explanatory variable X. Thus β_1 is the average regression coefficient like β_0 is the average intercept. The first part of equation (3.21), $\beta_0 + \beta_1 x_{1ij}$ is called the fixed part of the model and the second part, $U_0 + U_1 x_{1ij}$ is called the random part. The term $U_1 x_{1ij}$ can be regarded as a random interaction between group and X. This model implies that the groups are characterized by two random effects: their intercept and their slope. These two group effects U_{0j} and U_{1j} will not be independent, but correlated. Further, it is assumed that, for different groups, the pairs of random effects (U_{0j}, U_{1j}) are independent and identically distributed. The random intercept variance, var (U_{0j}) = σ_0^2, the random slope variance, var (U_{1j}) = σ_1^2 , and the covariance between the two random effects Covar (U_{0j}, U_{1j}) = σ_{01} , are called variance components (Snijders and Bosker, 1999).

The model for a single explanatory variable discussed above can be extended by including more variables that have random effects. Suppose that there are k level-one explanatory variables X_1, X_2,…, X_k, and consider the model where all X-variables have varying slopes and random intercept. That is

$$\log it(p_{ij}) = \log\left[\frac{p_{ij}}{1-p_{ij}}\right] = \beta_{0j} + \beta_{1j}x_{1ij} + \beta_{2j}x_{2ij} + ... + \beta_{kj}x_{kij}$$

(3.22)

Letting

$\beta_{0J} = \beta_0 + U_{0J}$ and $\beta_{hj} = \beta_h + u_{hj}$, *for* $h = 1,2,...,k$

$$\log it(p_{ij}) = \log\left[\frac{p_{ij}}{1-p_{ij}}\right] = \beta_0 + \sum_{h=1}^{k}\beta_h X_{hij} + U_{0j} + \sum_{h=1}^{k}U_{hj}X_{hij} \quad (3.23)$$

The first part of this model, $\beta_0 + \sum_{h=1}^{k}\beta_h X_{hij}$ is the fixed part and the second part $U_{0j} + \sum_{h=1}^{k}U_{hj}X_{hij}$, is the random part of the model (Snijders and Boskers, 1999).

3.3.2.1.6 Intra-class Correlation Coefficient (ICC)

The other fundamental reason for applying multilevel analysis is the existence of intra-class (intra-regional) correlation arising from similarity of contraceptive use for women in the same region compared to those of different regions. The intra-class correlation coefficient (ICC) measures the proportion of variance in the outcome explained by the grouping structure. ICC can be calculated using an intercept-only model. This model can be derived from "Eq. (3.22)" by excluding all explanatory variables, which results in the following equation: $\log it(p_j) = \beta_0 + U_{0j}$. The ICC is then calculated based on the following formula:

$$ICC = \frac{\sigma_{u0}^2}{\sigma_{u0}^2 + \sigma_e^2} \quad (3.24)$$

where, σ_e^2 is variance of individual (lower) level units.

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

$$ICC = \frac{\sigma_{u0}^2}{\sigma_{u0}^2 + 3.29} \qquad (3.25)$$

3.3.2.1.7 Estimation and Testing Technique for Multilevel logistic model

Parameter estimation for multilevel logistic model is not straightforward like the methods for ordinary logistic regression. The most common methods for estimating multilevel logistic models are based on likelihood. Among the methods, Marginal Quasi Likelihood or MQL [Goldstein (1991), Goldstein and Rasbash (1996)] and Penalized Quasi Likelihood or PQL [Laird (1978) and Breslow and Clayton (1993)] are the two prevailing approximation procedures. Both MQL and PQL are based on Taylor series expansion to achieve the approximation. Based on the first and second term of Taylor expansion, MQL and PQL are often known as first order MQL and second-order MQL, first-order PQL and second-order MQL respectively. 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. An important part of modeling involves testing parameters and models to see which parts of the multilevel model are statistically important. For fixed coefficients of multilevel logistic regression tests about parameters are done using the Wald test. The random part of multilevel logistic regression parameters is estimated based on t-test or Z-test. Parameter estimation in hierarchical generalized linear models is more complicated than the hierarchical linear models. The most frequently used kind of approximation method used is based on a first-order or second-order Taylor series expansion of the link function. There are different methods of parameter estimations which are implemented by various software packages such as, MLwiN, STATA and SAS. In this study, the multilevel data has been analyzed by the SAS and STATA software packages (Snijders and Bosker, 1999).

3.3.2.1.8 Multilevel model selection criteria: AIC and BIC

The AIC and the BIC are two common measures for comparing maximum likelihood models. AIC and BIC are defined as:

$$AIC = -2 \times \ln (likelihood) + 2 \times k$$

$$BIC = -2 \times \ln (likelihood) + \ln (N) \times k$$

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 $-2 \times \ln$ (likelihood); the larger the value, the worse the fit. Complexity is measured positively, either by $2 \times k$ (AIC) or ln (N) $\times k$ (BIC).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 and Schwarz, 1978).

CHAPTER FOUR

STATISTICAL DATA ANALYSIS

4.1 Introduction

The main purpose of this chapter is to analyze the effect of different socio-economic, demographic and other proximate determinants of the status of current usage of contraceptive methods among married women in Ethiopia using the data from the 2011Ethiopian Demographic and Health Survey (EDHS). Accordingly, the analysis is carried out in three sections. In the first section, results of descriptive statistics are presented; in the second section, we identified and examined the determinants of contraceptive use among married women by using ordinary logistic regression with the help of SPSS software. Finally, multilevel logistic regression model was employed to examine the factors and variations in contraceptive use across regions with the help of STATA software.

4.2 Results of descriptive statistics

The major socio-economic, demographic and proximate background characteristics of the respondents (women) are presented in Table 4.1. Out of the 9,324 married women, 75.2 percent did not use contraceptives while 24.8 percent of these women used contraceptives at the time of the survey.

The proportion of contraceptive use differed by place of residence. Among the married women who resided in urban areas, 47.7 percent were using contraceptives and the remaining 52.3 percent married women were non users of contraceptives. Among rural women, 17.7 percent used contraceptives and 82.3 percent did not use contraceptives. The prevalence of contraceptive use was higher among married women who were residing in urban areas (47.7%) as compared to those in rural area (17.7%). Moreover, women who lived in different regions had different status on the use of contraceptives. The highest proportion (70.4%) of married women using contraceptives was observed in Addis Ababa followed by Amhara (31.7%) and the least proportion (3.3%) of women using contraceptive methods was observed in Somali region, followed by Afar region (6.4%). There appeared to be some variation in the proportion of women using contraceptives in the different regions of Ethiopia.

The highest percentage (28.0%) of using contraceptives for married women was observed in the age group 30-34 followed by the age group 20-24 (27.0%) and the lowest percentage (10.7%) of using contraceptives was observed in the age group 45-49.

Table 4.1 shows that the proportion of married women using contraceptive methods was 56.2 percent among women who had secondary or higher education. The proportion of women who used contraceptive methods was 33.8 percent among married women who had primary education and 16.6 percent among women with no education. On the other hand, 54.1 percent of the women whose husbands/ partners had secondary or higher education level were using contraceptive methods while 28.5% of women whose husbands had primary education were using contraceptive methods and only 15% of women whose husbands had no education were using contraceptive methods during the survey.

With regard to the number of living children, the highest percentage (32.3%) of women who used contraceptives were those women who had 1-2 children followed by those women who had three or more living children (21.0 percent).Moreover, the least proportion (17.0 %)of the married women using contraceptive methods had no children.

Married women who were exposed to any kind of mass media, 32.3 percent used contraceptive methods and 67.7 percent did not use any contraceptive methods. Of those married women who were not exposed to any mass media, only 13.4 percent used contraceptive methods. Among women without knowledge about family planning methods, 16.7 percent used contraceptive methods and 39.6 percent of married women who had knowledge about family planning methods used contraceptives.

The proportion of women who used contraceptive methods was 31.9 percent among married women who had been visited by a family planning worker during the last 12 months before the survey and 22.5 percent among those who had not been visited during the last 12 months before the survey. Of the married women who had desire for more children, 29.9 percent used contraceptives while 21.4% of those women who had no desire for more children used contraceptive methods. Results of descriptive statistics in Table 4.1 also showed that 34.5% of married women who were employed in the non agricultural sector used contraceptives. Likewise, 19.7% of married women who were not working used contraceptive methods. About 22.5% of married the women who were employed in the agricultural sector were using contraceptive methods. Similarly, 40.4% of the married women whose partners/husbands were employed in the non agricultural sector were using contraceptive methods; 17.9% of the married women whose partners/husbands were employed in agricultural sector were using contraceptive methods and 12.2 percent of the married women whose partners/husbands were not working used contraceptive methods.

The percentage of women who used contraceptive methods was higher among those women who were followers of the Coptic Orthodox (35.3%) followed by Protestant (24.7 %). The lowest percentage (12.8%) of using contraceptive methods was observed among married women who were followers of Catholic, traditional and others followed by Muslim women (15.8%).

Table 4.1 Descriptive Characteristics of Married Women in the Age Group 15-49

		Contraceptive Use				
Variable	Categories	Using	Percent	Not using	Percent	Total
Age of women	15-19	138	19.5%	571	80.5%	709
	20-24	451	27.0%	1165	73.0%	1596
	25-29	593	26.2%	1671	73.8%	2264
	30-34	440	28.0%	1134	72.0%	1574
	35-39	395	26.7%	1084	73.3%	1479
	40-44	188	19.4%	779	80.6%	967
	45-49	79	10.7%	656	89.3%	735
Place of resident	Urban	980	47.7%	1073	52.3%	2053
	Rural	1284	17.7%	5987	82.3%	7271
Visited by FP workers last 12 months	No	1706	22.5%	5871	77.5%	7577
	Yes	558	31.9%	1189	68.1%	1747
Region	Tigray	199	21.1%	744	78.9%	943
	Afar	60	6.4%	881	93.6%	941
	Amhara	402	31.7%	867	68.3%	1269
	Oromiya	345	26.0%	983	74.0%	1328
	Somali	21	3.3%	614	96.7%	635
	Ben-Gumz	204	23.6%	662	76.4%	866
	SNNP	241	10.6%	840	77.7%	1081
	Gambela	152	23.3%	499	76.7%	651
	Harari	177	31.6%	384	68.4%	561
	Addis Abeba	375	70.4%	158	29.6%	533
	Dire Dawa	128	24.8%	388	75.2%	516
Highest education level of women	No	1025	16.6%	5139	83.4%	6164
	Primary	812	33.8%	1588	66.2%	2400
	Secondary and +	427	56.2%	333	43.8%	760
Religion	Orthodox	1188	35.3%	2174	64.7%	3362
	Protestant	392	24.7%	1198	75.3%	1590
	Moslem	653	15.8%	3476	84.2%	4129
	Others	31	12.8%	212	87.2	243
Number of living children	0	160	17.0%	779	83.0%	939
	1-2	976	32.3%	2046	67.7%	3022

	3+	1128	21.0%	4235	79.0%	5363
Knowledge about FP methods	No	1041	16.7%	5194	83.3%	6235
	Yes	1223	39.6%	1866	60.4%	3089
Partner‟s/husband‟s education level	No	724	15.0%	4091	85.0%	4815
	Primary	949	29.5%	2273	70.5%	3222
	Secondary and +	696	54.1%	591	45.9%	1287
Husband‟s /partner‟s occupation	Not working	22	12.2%	158	87.8%	180
	Agricultural	1150	17.9%	5288	82.1%	6438
	Non-agricultural	1092	40.4%	1614	59.6%	2706
Desire for more children	Yes	1323	21.4%	4853	78.6%	6176
	No	941	29.9%	2207	70.1%	3148
Occupation of women	Not working	946	19.7%	3864	80.3%	4810
	Non-agricultural	868	34.5%	1650	65.5%	2518
	Agricultural	450	22.5%	1546	77.5%	1996
Exposure to any mass media	No	530	13.4%	3425	86.6%	3955
	Yes	1734	32.3%	3635	67.7%	5369

4.3 Determinants of Contraceptive Use: Results of Logistic Regression Analysis

Multiple logistic regression was used to analyze the effect of each of the independent variables on women‟s contraceptive use, while controlling for the other independent variables. Enter method variable selection procedure was employed to select the important determinants of contraceptive use among married women in SPSS software. The statistical significance of the individual regression coefficients is tested using the Wald chi-square statistic. Accordingly, region, place of residence, age of a woman, religion of a woman, educational level of women, occupation of a woman, desire for more children by women, visited by FP worker in the last 12 months before the survey, partner‟s/husband's level of education, partner's occupation, exposure to mass media and number of living children of women were found to be significant predictors for contraceptive use (see Table4.2).

The model revealed that the likelihood of contraceptive use of married woman was lowest for age group 45-49 (OR=0.215;95% CI: 0.150-0.308) compared to the age group 15-19. Women in the age group 40-44 were 51.6 percent less likely to use contraceptives as compared to women in the age group 15-19.

Married women who resided in the rural areas were 54.1 percent less likely to use contraceptive methods compared with those from the urban areas (OR=0.459; 95% CI: 0.380-0.555). Women who resided in the Amhara region are 2.338 times more likely to use contraceptives when compared with those residing in Dire Dawa. Women who lived in Addis Ababa were 2.738 times more likely to use contraceptives than women in Dire Dawa (OR=2.738; 95% CI: 2.015-3.720). Married women who lived in Oromiya region were 56.0 percent more likely to use contraceptives compared to women in Dire Dawa. Conversely, married women who lived in Somali were 79.5 percent less likely to use contraceptives compared to women in Dire Dawa (OR=0.205; 95% CI: 0.124-0.339) and married women who lived in Affar region were 54.3 percent less likely to use contraceptive methods compared to women who lived in Dire Dawa.

Married women who were followers of Coptic Orthodox religion were 2.424 times more likely to use contraceptives than those who were followers of religions other than Coptic Orthodox, Protestant and Muslim. Protestant married women were 61.6 percent more likely to use contraceptives compared to those who were followers of religions other than Coptic Orthodox, Protestant and Muslim. The likelihood of using contraceptive methods among married women who were followers of Muslim was not significantly different from those who were followers of religions other than Coptic Orthodox, protestant and Muslim.

From Table 4.2, we also observed that women who did not desire for more children were 71.7 percent more likely to use contraceptives compared to women who desired for more children (OR=1.717; 95% CI=1.512-1.950). Women with children had a significantly higher odds (or probability) of using contraception than women having no children. On the other hand, the odd of using contraceptives was higher for those with children than those women with no children. That is, the odds of using contraceptives for a woman with three or more child was 2.395 times the odds for a woman who had no children whereas, the odds of using contraceptives for woman who had one or two children were 2.492 times the odds for a woman with no children.

Married women who had primary education were 40.7 percent more likely to use contraceptives compared to uneducated women OR=1.407 (95% CI: 1.229-1.612). Women who had secondary and higher education were 65.6 percent more likely to use contraceptives compared to uneducated women OR=1.656 (95% CI: 1.299-2.111). Women whose partners/husbands had primary level education are 34.4% more likely to use contraceptive methods as compared to women whose husbands/partners are uneducated. Those women who were employed in the non-agricultural sector were 23.5 percent more likely to use contraceptive methods compared to women who were not working. The odds of contraceptive use for women whose partners/husbands worked in the non- agricultural sector was 75.6 percent higher than the odds of contraceptives use by women whose partners/husbands were not working OR=1.756 (95% CI: 1.065-2.893).

Women who were exposed to mass media messages via Radio, TV or newspapers/magazine were 52.7 percent more likely to use contraceptive methods compared to those women who were not exposed to mass media messages via radio, TV or newspapers/magazine OR=1.527 (95% CI: 1.332-1.750). The odds of contraceptive use for those women who heard FP methods on radio, TV or in newspapers/magazine were 33.7 percent more likely to use contraceptives compared to those women who did not have about FP information methods on radio, TV or in newspapers/ magazine (OR=1.337, 95% CI: 1.168-1.530). Women who were visited by a family planning worker during the last 12 months were 33.2 percent more likely to use contraceptives than those who were not visited during the last 12 months before the survey (OR=1.332; 95% CI: 1.167-1.520).Those women who had knowledge about family planning methods were 33.7 percent more likely to use contraceptives compared to women who had not knowledge about family planning methods.

Table 4.2 Maximum likelihood estimates for ordinary logistic regression of predicting contraceptive use among married women in the age group 15-49.

Covariate	Categories	$\hat{\beta}$	S.E.	Wald	df	P-value	$\widehat{OR}$	95% C.I. OR Lower	Upper
Age	Overall			120.479	6	.000*			
	15-19(ref.)								
	20-24	-.016	.126	.017	1	.896	.984	.769	1.259
	25-29	-.208	.129	2.575	1	.109	.812	.630	1.047
	30-34	-.182	.141	1.663	1	.197	.833	.632	1.099
	35-39	-.263	.145	3.278	1	.070	.769	.578	1.022
	40-44	-.726	.160	20.496	1	.000*	.484	.353	.663
	45-49	-1.538	.185	69.349	1	.000*	.215	.150	.308
Residence	Urban(ref.)								
	Rural	-.778	.096	65.160	1	.000*	.459	.380	.555
Visited by FP workers	No(ref.)								
	Yes	.287	.067	18.087	1	.000*	1.332	1.167	1.520
Region	Overall			270.279	10	.000*			
	Dire dawa (ref.)								
	Tigray	-.158	.160	.972	1	.324	.854	.624	1.169
	Affar	-.784	.182	18.528	1	.000*	.457	.320	.652
	Amhara	.849	.149	32.353	1	.000*	2.338	1.745	3.132
	Oromiya	.445	.141	9.906	1	.002*	1.560	1.183	2.057
	Somali	-1.583	.256	38.237	1	.000*	.205	.124	.339

	Ben-gumuz	.546	.150	13.218	1	.000*	1.727	1.286	2.318
	SNNP	.389	.158	6.089	1	.014*	1.475	1.083	2.010
	Gambela	.401	.169	5.654	1	.017*	1.493	1.073	2.078
	Harari	.292	.154	3.617	1	.057	1.339	.991	1.810
	Addis Ababa	1.007	.156	41.517	1	.000*	2.738	2.015	3.720
Education of level women	Overall			28.946	2	.000*			
	No education(ref.)								
	Primary education	.342	.069	24.345	1	.000*	1.407	1.229	1.612
	Secondary and +	.504	.124	16.561	1	.000*	1.656	1.299	2.111
Religion	Overall			53.704	3	.000*			
	Others (ref.)								
	Coptic Orthodox	.885	.213	17.350	1	.000*	2.424	1.598	3.676
	Protestant	.480	.209	5.277	1	.022*	1.616	1.073	2.434
	Muslim	.384	.213	3.249	1	.071	1.468	.967	2.228
Number of living children	Overall			69.748	2	.000*			
	0 (ref.)								
	1-2	.913	.110	69.531	1	.000*	2.492	2.011	3.089
	3+	.873	.126	48.027	1	.000*	2.395	1.871	3.065
Knowledge about FP methods	No(ref.) Yes	.290	.069	17.715	1	.000*	1.337	1.168	1.530
Occupation of husband	Overall			12.606	2	.002*			
	Not working(ref.)								
	Agricultural	.293	.257	1.306	1	.253	1.341	.811	2.218
	Non agricultural	.563	.255	4.879	1	.027*	1.756	1.065	2.893
Desire for more children	Want(ref.) Do not want	.541	.065	69.439	1	.000*	1.717	1.512	1.950
Occupation of women	Overall			11.112	2	.004*			
	Not working(ref.)								
	Non-agricultural	.211	.066	10.265	1	.001*	1.235	1.085	1.405
	Agricultural	.147	.077	3.588	1	.058	1.158	.995	1.348
Mass media exposure	No(ref.) Yes	.423	.070	36.959	1	.000*	1.527	1.332	1.750
Husband education level	Overall			19.746	2	.000*			
	No education(ref.)								
	Primary	.295	.067	19.331	1	.000*	1.344	1.178	1.533
	Secondary and +	.168	.108	2.410	1	.121	1.183	.957	1.462
	Constant	-3.381	.371	82.855	1	.000*	.034		

*significant ($p<0.05$), ref=reference category, estimated odds ratio = $\widehat{OR}$

4.4 Goodness of Fit and Model Diagnostics for logistic regression

4.4.1 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.

4.4.1.1 Likelihood-Ratio Test

The most common assessment of overall model fit in logistic regression is the likelihood ratio test, which is simply the chi-square difference between the null model (i.e., with the constant only) and the model containing a set of predictors. Under model summary in the Appendix 1.1 we see that the -2 Log Likelihood statistics is 8315.924. This statistic tells how much improvement is needed before the predictors provide the best possible prediction of the dependent variable (status of current contraceptive use), the smaller the statistic the better the model. The statistic for the model that had only the intercept is $-2LL_0$= 2124.107+ 8315.924=11440.031. The inclusion of the parameters reduced the -2 Log Likelihood statistic by 11440.031 – 8315.924 = 2124.107, which is reflected in the model chi-square for omnibus test.

The omnibus Test of model coefficients test if the model with the predictors is significantly different from the model with only the intercept. The omnibus test may be interpreted as a test of the capability of all predictors in the model jointly to predict the response (dependent) variable. The omnibus test of model coefficients is used to assess the overall fit of the logistic regression model. The results (χ^2=2124.107, d.f=34, p-value<0.001), show that the fit is adequate, meaning that at least one of the predictors is significantly related to the response variable That is, the null hypothesis that there is no difference between the model with only a constant and the model with independent variables was rejected (see Appendix 1.1).

4.4.1.2 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. Since the p-value is 0.082 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 (seeTable4.3).

Table4.3 Hosmer-Lemeshow test

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	14.005	8	.082

Contingency Table for Hosmer and Lemeshow Test

		CCU = Not using		CCU = using		Total
		Observed	Expected	Observed	Expected	
Step 1	1	944	930.656	6	19.344	950
	2	887	884.608	47	49.392	934
	3	844	844.232	88	87.768	932
	4	796	811.974	137	121.026	933
	5	784	775.461	148	156.539	932
	6	725	732.790	207	199.210	932
	7	674	679.844	258	252.156	932
	8	602	606.259	330	325.741	932
	9	482	484.554	451	448.446	933
	10	276	263.623	638	650.377	914

4.4.1.3 Classification table

A classification table shows the validity of predicted probabilities. The accuracy of the classification is measured by its sensitivity (the ability to predict an event correctly) and specificity (the ability to predict the non-occurrence of an event correctly). Sensitivity is the proportion of event responses that were predicted to be events. Specificity is the proportion of nonevent responses that were predicted to be nonevents. The classification Table 4.4 shows that 36.0 percent of women who were using contraceptive were correctly classified whereas 93.9 percent of women who were not using contraceptive methods were correctly classified. The overall correct prediction was 79.5 percent which is an improvement over the chance level

Table 4.4. Classification table

Classification Table[a]

Observed			Predicted		
			CCU		Percentage Correct
			Not using	Using	
Step 1	CCU	Not using	6584	430	93.9
		Using	1478	832	36.0
	Overall Percentage				79.5

a. The cut off value is .500

4.4.2 Model diagnostics: influential observations and outliers

The adequacy of the fitted model was checked for possible presence and treatment 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 1.2 and Fig1 in the Appendix1).

4.5 Determinants of Contraceptive Use: Results of a multilevel logistic regression analysis

In the multilevel analysis, a two-level structure is used with regions as the second-level units and women as the first level units. Before we proceed to multilevel logistic regression analysis, we need to test the heterogeneity of contraceptive use among women across eleven regions of Ethiopia.

A chi-square test was applied to assess heterogeneity in the proportion of women who were using contraceptives among the 11 regions. The test yield $\chi^2 = 1009.776$, df =10, P<0.001. Thus, there is evidence for heterogeneity with respect to contraceptive use across regions.

Three multilevel logistic regressions have been considered as follows. First, an empty model with random effect and no covariates was examined for the over all probability of contraceptive use. Second, a multilevel model for random effect and a fixed slope covariate was examined for contraceptive use. Finally, a random coefficient multilevel logistic regression model with random effect for contraceptive use was analyzed.

4.5.1 Multilevel logistic regression Model comparison

Before interpreting multilevel models, we compare the three multilevel logistic regression models (nested models) considered. To do so, deviance, AIC and BIC were used. The deviance of the empty model with random intercept (deviance = 9517.876) and random intercept and fixed slope model (deviance =8370.644) indicate that the random intercept and fixed coefficient (slope) model is better than the empty model with random intercept. In addition to this the AIC value of the empty model with random intercept(AIC = 9521.876) is larger than that for the random intercept and fixed coefficient model (AIC =8422.644), which implies that random intercept and fixed slope model is better than the empty model with random intercept in predicting contraceptive use across regions. The significant deviance-based chi-square value for random intercept model indicates that the random intercept and fixed slope model is better than single level multiple logistic regression in predicting contraceptive use across regions as well (see Table4.5 and Table4.7).

The deviance of a fixed slope and random intercept (deviance = 8370.644) and random coefficient model (deviance = 8265.837) show that random coefficient model is better than the random intercept and fixed slope model. The AIC value of the random coefficient model (AIC = 8335.837) is smaller than the random intercept and fixed coefficient model (AIC =8422.644) implying that random coefficient model is better compared to the random intercept and fixed slope model in describing contraceptive usage status (see Table4.5). Furthermore, the significant deviance-based chi-square value for random coefficient model indicates that the random coefficient model is better than the multiple logistic regression model in explaining contraceptive use (see Table 4.9).

Table4.5 Summary of multilevel logistic regression model selection criteria

Model Selection Criteria	Multilevel Empty Model	Multilevel Random intercept Model	Multilevel Random coefficient Model
Deviance Based chi-square	922.16	267.09	371.90
Deviance	9517.876	8370.644	8265.837
AIC	9521.876	8422.644	8335.837
BIC	9536.157	8608.293	8585.750

4.5.1 The Empty random intercept logistic regression analysis

The simplest non–trivial specification of the hierarchical linear model is a model in which only the intercept varies between level two units and no predictor (explanatory) variables are entered in the model. That is a random intercept or variance components model that allows the overall probability of contraceptive use to vary across regions.

The deviance-based Chi-square (χ^2 = 922.16, d.f=1, p-value<0.001) in Table 4.6, shows the difference in -2*log likelihood between an empty model without random effect and an empty model with random effect and implies that the empty model with random effect is better than the empty model without random effect. Conversely, the variance of the random effect of the region random intercepts (σ_0^2=1.017086, p-value=0.0226) reveals that there is a significant difference in contraceptive use across regions. This implies that multilevel model is more appropriate relative to single level logistic regression model. The intercept $\hat{\beta}_0$ = -1.247059 interpreted as the odds of using contraceptives in an average region. That is the intercept informs us that the average probability of contraceptive use everywhere in Ethiopia is exp (-1.2471)/ [1+exp (-1.2471)] = 0.2232. The empty model with random effect also helps to calculate the between region variations by the help of intra -class correlation coefficient (ICC). ICC for this model is calculated by using formula (3.25) and this result ICC=0.2718 implied that 27.18% of the variation in the contraceptive use can be explained by grouping the women in regions (higher level units). The remaining (100-27.18%=72.82% of the variation of in contraceptive use is explained within region-lower level units.

Table 4.6 Results of empty random intercept Logistic regression model analysis

Fixed Part	**Coef.**	**S.E**	**Z-value**	**P-value**	**[95% CI]**	
β_o = intercept	-1.247059	.3057705	-4.08	0.000*	-1.846358	-.6477602
Random Part	**Estimate**	**S.E**	**Z-value**	**P-value**		
Level-two variance, σ_o^2=var(u_{oj})	1.017086	.4441632	2.290	0.022*		
Deviance based Chi-square		922.16		0.000*		
Deviance	9517.876					
AIC	9521.876					
BIC	9536.157					

4.5.2 Random Intercept and fixed coefficient logistic regression analysis

In a random intercept and fixed coefficient multilevel logistic regression model, we allowed the probability of contraceptive use 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.

According to the result of the random intercept with fixed slope model, the fixed part showed that age of woman(40-44,45-49), number of living children(1 or 2 and 3+), mother"s education (primary, secondary and higher), desire for more children, religion (Coptic Orthodox, Protestant) , knowledge about FP, visited by FP workers, occupation of women and husbands (non-agricultural sector employee), exposure to mass media and place of residence were found to be significant determinants of variation in contraceptive use in all regions with respect to the corresponding reference categories (see Table 4.7). The estimated coefficients and odds ratio have similar interpretation like in ordinary logistic regression discussed above. However, the result of the random part has additional information which is discussed below.

Table 4.7 Results of Random Intercept and Fixed Coefficient Model analysis of Contraceptive use among married women in the group 15-49

Fixed effects

Covariate	Estimated coefficient	S.E	Z-value	P-value
Age				
15-19(ref.)				
20-24	-.0148331	.1256691	-0.12	0.906
25-29	-.2049446	.1294251	-1.58	0.113
30-34	-.178595	.1412995	-1.26	0.206
35-39	-.2598632	.1450829	-1.79	0.073
40-44	-.7241231	.1602565	-4.52	0.000*

45-49	-1.534801	.1846541	-8.31	0.000*
Resident				
Urban (ref.)				
Rural	-.7765356	.0960817	-8.08	0.000*
Visited by FP workers				
No(ref.)				
Yes	.2883636	.067383	4.28	0.000*
Education level of women				
No education(ref.)				
Primary	.3444033	.0692233	4.98	0.000*
Secondary and +	.5086033	.1238446	4.11	0.000*
Religion				
Others(ref.)				
Coptic Orthodox	.8856628	.2124276	4.17	0.000*
Protestant	.4816068	.2090836	2.30	0.021*
Muslim	.3704553	.2128295	1.74	0.082
Number of living children				
0(ref.)				
1-2	.9124483	.1094633	8.34	0.000*
3+	.8681222	.1259091	6.89	0.000*
Knowledge about FP method				
No(ref.)				
Yes	.291159	.0688654	4.23	0.000*
Occupation of husbands				
Not working (ref.)				
Agriculture	3060783	.2562412	1.19	0.232
Non agriculture	.5701442	2542871	2.24	0.025*
Desire more children				
No more want(ref.)				
Want	.5459894	.0648849	8.41	0.000*
Occupation of women				
Not working(ref.)				
Non agricultural	.2135482	.0657781	3.25	0.001*
Agricultural	.1502667	.0774449	1.94	0.052
Mass media exposure				
No(ref.)				
Yes	.4237822	.0696103	6.09	0.000*

Education level of husbands				
No education(ref.)				
Primary	.2976197	.0671259	4.43	0.000*
Secondary and +	.1698811	.1080361	1.57	0.116
Intercept	-3.253477	.4103612	-7.93	0.000*
Random effect	**Variance components**	**Z-value**	**S.E**	**P-value**
Random intercept , $\sigma_0^2 = Var(U_{oj})$	.4609648	.2100498	2.195	0.0282*
Deviance based chi-square	267.09			0.000*
Model selection criteria				
Deviance	8370.644			
AIC	8422.644			
BIC	8608.293			

*significant (p<0.05), ref=reference category

The random part of random intercept and fixed slope model shows that the intercept variance of the random effect is 0.46 whereas the variance of the intercept for the empty multilevel model is 1.02. The variance of random effect of the intercept and fixed slope model decreased compared to random effect of the intercept empty model. The reduction of the random effects of the intercept variance is due to the inclusion of fixed explanatory variables. That is, taking into account the fixed independent variables can provide extra predictive value on contraceptive use in each region. The significance of the random effect intercept variance indicates that there is a significant regional random effect variation on contraceptive use among women (see Table4.7).This implies that there is still unexplained variation on contraceptive use across regions.

The random intercept and fixed slope multilevel logistic regression model also helps to compare the performance of contraceptive use for married women across regions. The results of this model in Table 4.8 show that estimated regional random effects of intercept in eleven regions of Ethiopia. Among these regions the random effect of intercept for contraceptive use in Somali, Affar, Amhara and Addis Ababa are statistically significant at 5% level of significance. The estimated random regional effects revealed that the average use of contraceptive methods in a particular region. The odds of contraceptive use methods for regional random effects of intercept in Affar region is exp (-0.88) =0.42 and Somali is exp (-1.55) =0.21 which are less than one and these result show that average contraceptive use in Affar and Somali was very low compared to the average of all regions. The odds of contraceptive methods for random regional effects of Addis Ababa and Amhara are exp (0.85) =2.33 and exp (0.70) =2.01 respectively. These results indicate that Addis Ababa and Amhara region had better performance in the average of contraceptive use compared to the average of all regions.

Table 4.8 Results of estimated random effects of intercepts for each region in explaining contraceptive use

Effect	Subject	Estimate	S.E	Z-Value	P-value
Intercept	REGION Tigray	-0.2991	0.2262	-1.32	0.1862
Intercept	REGION Affar	-0.8784	0.2432	-3.61	0.0003*
Intercept	REGION Amhara	0.6982	0.2205	3.17	0.0015*
Intercept	REGION Oromiya	0.3004	0.2173	1.38	0.1670
Intercept	REGION Somali	-1.5497	0.2863	-5.41	0.0001*
Intercept	REGION Ben-Gumuz	0.3995	0.2224	1.80	0.0725
Intercept	REGION SNNP	0.2400	0.2245	1.07	0.2852
Intercept	REGION Gambela	0.2507	0.2315	1.08	0.2789
Intercept	REGION Harari	0.1531	0.2287	0.67	0.5034

Effect	Subject	Estimate	S.E	Z-Value	P-value
Intercept	REGION Addis Ababa	0.8477	0.2309	3.67	0.0002*
Intercept	REGION Dire Dawa	-0.1309	0.2331	-0.56	0.5744

4.5.3 The Random Coefficient Logistic Regression Analysis

So far, we have allowed the probability of contraceptive use to vary across regions, assuming that the effects of the explanatory variables are the same for each region. However, effect of exposure to mass media, effect of being visited by family planning workers and the effect of religion of women on contraceptive use might vary across regions. So, in the random coefficient model, we need to introduce a random coefficient of: exposure to mass media, visited by family planning workers and religion of women to vary randomly across regions.

The results of fixed part of the random coefficient model showed that age of women(40-44,45-49), number of living children(1 or 2 and 3+), mother"s education (primary, secondary and higher), desire for more children, religion(orthodox,), knowledge about FP, visited by FP workers, occupation of women (non-agricultural sector employee), exposure to mass media and place of residence are significant determinants of variation in contraceptive use in all regions with respect to the corresponding categories (see Table 4.9).

Table4.9 Results of random coefficient logistic regression analysis for contraceptive use among married women in the age groups 15-49

Fixed effects Covariates	Estimated coefficient	S.E	Z-value	P-value
15-19(ref.)				
20-24	-.0298871	.1266672	-0.24	0.813
25-29	-.2271257	.1304687	-1.74	0.082
30-34	-.2019685	.1424923	-1.42	0.156
35-39	-.2737467	.1464466	-1.87	0.062
40-44	-.7481601	.1615695	-4.63	0.000*
45-49	-1.568881	.1857791	-8.44	0.000*
Resident				
Urban (ref.)				
Rural	-.7073317	.0982851	-7.20	0.000*
Visited by FP workers				
No(ref.)				
Yes	.2923026	.082638	3.54	0.000*
Education level of women				
No education(ref.)				
Primary	.3187072	.0698821	4.56	0.000*
Secondary and +	.4864145	.1254747	3.88	0.000*
Religion				
Others (ref.)				
Coptic Orthodox	.9158826	.2661567	3.44	0.001*
Protestant	.421017	.3545883	1.19	0.235
Muslim	.1647662	.4624541	0.36	0.722
Number of living children				
0(ref.)				
1-2	.930733	.1101524	8.45	0.000*
3+	.9038881	.1269567	7.12	0.000*
Knowledge about FP method				
No(ref.)				
Yes	.2775081	.0694122	4.00	0.000*
Occupation of husbands				
Not working (ref.)				
Agriculture	.242895	.2621008	0.93	0.354
Non-agriculture	.4989011	.2603261	1.92	0.055
Desire more children				

No more wants(ref.)				
Wants	.5231176	.0655132	7.98	0.000*
Occupation of women				
Not working(ref.)				
Non agricultural	.188297	.0662127	2.84	0.004*
Agricultural	.0822788	.0782486	1.05	0.293
Mass media exposure				
No(ref.)				
Yes	.5250268	.2081681	2.52	0.012*
Education level of husbands				
No education (ref.)				
Primary	.2754099	.067667	4.07	0.000*
Secondary and +	.1771354	.1092324	1.62	0.105
Intercept	-2.97653	.4053382	-7.34	0.000*

Random effects **variance components**

	Estimate	**S.E**	**Z-value**	**P-value**
$\sigma_0^2 = \mathrm{var}(u_{0j})$	.4835806	.299638	1.614	0.1065
$\sigma_1^2 = \mathrm{var}(u_{1j})$	.194641	.066543	2.925	0.0034*
$\sigma_2^2 = \mathrm{var}(u_{2j})$	.017980	.011841	1.519	0.1288
$\sigma_3^2 = \mathrm{var}(u_{3j})$	.379105	.138834	2.731	0.0063*
$\sigma_{01} = \mathrm{cov}(u_{0j}, u_{1j})$	-.221857	.136950	-1.620	0.1052
$\sigma_{02} = \mathrm{cov}(u_{0j}, u_{2j})$	.052855	.051131	1.034	0.3011
$\sigma_{03} = \mathrm{cov}(u_{0j}, u_{3j})$	.061088	.147274	0.415	0.6781
$\sigma_{12} = \mathrm{cov}(u_{1j}, u_{2j})$	-.020854	.023538	-0.886	0.3756
$\sigma_{13} = \mathrm{cov}(u_{1j}, u_{3j})$	-.191762	.070644	-2.714	0.0066*
$\sigma_{23} = \mathrm{cov}(u_{2j}, u_{3j})$	-.030908	.032918	-0.939	0.3477
Deviance based chi-square		371.90		

Model fit statistics	
Deviance	8265.837
AIC	8335.837
BIC	8585.750

*significant (P<0.05), ref. = reference category

Table 4.9 shows that the value of Var (u_{0j}), Var (u_{1j}), Var (u_{2j}) and Var (u_{3j}) are the estimated variance of intercept, slope of religion, slopes of visited by FP workers and the slope of mass media exposure respectively. The random effect of the slope of religion and the slopes of the random effects of exposure to mass media such as radio, TV or in newspapers/magazine vary significantly at 5 percent levels of significance across regions. The variance component corresponding to the slope of visited by FP workers is insignificant. Hence, the random effects of women who were visited by visited by FP workers have no variation across regions.

The effect of exposure to mass media through TV, Radio or news papers/magazine as log-odds of use of contraceptive in region j is estimated as 0.525 $+\hat{U}_{1j}$ rather than being not exposed to mass media and the estimate of between-regions variance in the effect of exposure to mass media were 0.379, which is significant. And this result showed that there is a significant mass media effect variation across regions in explaining contraceptive use. The random effect of religion significantly varies across regions in describing the usage of contraceptives as well (see Table 4.9).The positive intercept for media covariance estimate implies that regions whose performance on contraceptive use is above-average of all regions (intercept residual $\hat{U}_0 > 0$) and above-average effect of media exposure all regions (slope of media residual $\hat{U}_1 > 0$).

Table 4.10 Random-effects of the random coefficient correlation matrix for regional level covariates for contraceptive use among married women in the age group 15-49

	Intercept	Religion	Visited by FPW	Media
Intercept	1			
Religion	-0.723	1		
Visited by FPW	0.568	-0.353	1	
Media	0.143	-0.705	-0.037	1

The correlation matrix contains the estimated correlation between random intercepts and the random slopes. Positive correlation between intercepts and slopes implies that regions with higher intercepts tend to have on average higher slopes. For example, the correlation between the intercept and random slope of exposure to mass media is 0.143, which implies that women who are exposed to mass media (radio, TV or newspapers) have better status of using contraceptives than those who were not exposed by a larger factor in regions with higher intercepts compared to regions with lower intercepts. 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 (see Table 4.10).

CHAPTER FIVE

DISCUISSION, CONCLUSION AND RECOMMENDATION

5.1 Discussion and Conclusion

This study was intended to identify scio-economic, demographic and other proximate determinants of contraceptive use among married women based on Ethiopian Demographic and Health Survey (EDHS 2011) data. Accordingly, descriptive analysis, multiple logistic regression analysis and multilevel logistic regression analysis were used. The results which are obtained are discussed as follows.

The descriptive analysis of the study revealed that only 24.8 percent of the sample married women were using contraceptives while 75.2 percent were not using contraceptives. The study identified the following socio-economic, demographic and proximate variables as determinants of contraceptive use among married women in Ethiopia: desire for more children by women, visited by FP worker in the last 12 months, occupation of husband/partner, women occupation, exposure to mass media, educational level of women, husbands‟/partners‟ education level, number of living children, age of a woman, religion and place of residence.

Women's level of education was found to be a basic determinant of contraceptive use. The results indicated that contraceptive use increase as women‟s educational level increased. Women who were more educated could afford to buy contraceptives, were more likely to reside in the urban areas where contraceptives are more accessible, were more informed about the available methods and were more likely to prefer small families than their less educated counterparts. Education also exposed women to information, empowers women, made them more likely to be employed outside their home environment, and created more awareness of their own health and the health of their children. Educated women may increase their authority with husbands, and affect fertility and use of family planning. Educated women are more likely to postpone marriage, and use contraceptive methods than are uneducated women. This finding is to the findings in previous studies (Dwivedi and Sundaram, 2000; Ainsworth et al. 1996).

Religion of women was also found one of the determinants of current contraceptive use. The study found that there is religious disparity in accepting contraceptive use. This could be due to the difference in perception of different religions concerning to marriage, reproductive behavior, and contraceptive methods. The other possible reason might be the fact that some religious societies assumed that a women‟s worth is measured in terms of her children. Even the use of contraceptive methods is not accepted by some cultures and religious societies. An important strategy to minimize this disparity is educating women through their religious leaders about the importance of contraceptive use for better success of family planning.

The result of this study showed that women who had one or more children were more likely to use contraceptives than women who had no children. Those women who had three or more children were more likely to use contraceptives than women who had no children. This could be because many women with larger number of living children were either on the limit to achieve or on achieving their preferred family size. Therefore, these women are likely to abandon pregnancy, showing interest in the adoption of contraceptive methods.

In this study, age of a woman was found to be a determinant factor of contraceptive use. The likelihood of contraceptive use was lowest in the age groups 40-44 and 45-49.

The results of this study also showed that there were significant regional differences in the use of contraceptives. The lowest likelihood of contraceptive use was observed in Somali and Afar regions. The reason for this difference might be limited access to mass Media messages such as radios, TV and newspapers on the issue of FP in these regions compared to other regions. The lowest level of contraceptive use in these regions could also be due to low availability of health facilities, health and family planning workers and become most of the women in these regions live in rural areas. In addition, women who live in Affar and Somali are predominantly Muslims which are less likely to use contraceptives than Christian women.

The finding of this study showed that women who heard family planning methods on radio, TV or in news papers one month before the survey had improved their level of contraceptive use. Women with information about family planning methods through radio, on TV or in news papers in the last month can create awareness about family planning. As a result, promoting family planning through mass media about family planning programs can be an important means of raising awareness, improving knowledge of contraceptive use.

The study also showed significance variation on contraceptive use among residence of women. That is, women residing in rural areas were less likely to use contraceptives than urban women. The reason could be attributed to differences in the availability of social services such as, educative information about methods and access to family planning and health care services. This also suggests that urban women may be more likely to use contraceptive particularly, modern contraceptive methods than rural women because of greater access to modern methods and medical care as well as other social facilities in urban areas. This supports the study by Bertrand et al. (1993) that contraceptives, particularly modern contraceptive use is higher in urban than in the rural areas.

Exposure to mass media has been an effective way towards contraceptive use. Exposure to mass media via radio, TV or newspapers is one of the determinants of contraceptive use. This study also found that mass media exposure had a profound effect on contraceptive use. Those women who were exposed to mass media had fewer children than those who were not exposed. This is because of the role of mass media in changing both patterns of contraceptive use and planning of ideal family size among those exposed to mass media. This finding is supported by previous studies (Dunn, 2001; Dwivedi and Sundaram, 2000; Bertrand et al., 1987).

Another finding of this study was that women employed in the non-agricultural sector were more likely to use contraceptive methods than women who were not working.

In addition to the ordinary logistic regression analysis, multilevel model analysis has been used in order to control for a complex sampling design. Multilevel modeling allows for a correct calculation of standard errors and also a more interesting insight into variation between higher level units. In general, the fixed effects of the explanatory variables included in the multilevel models had somewhat similar interpretation as that of the multiple logistic regression as discussed above whereas the random parts of the intercept and the coefficients provided additional information. In the empty with random intercept model and random intercept and fixed slope models, the overall variance of the constant term was found to be statistically significant, which indicates the existence of differences in contraceptive use among married women across regions. The random intercept and fixed slope model was also employed to compare the performance of contraceptive use among regions. An interesting finding of this model was that the rate of using contraceptive methods by women residing in Somali and Affar regions was below the average of all regions, while the rate for women in Addis Ababa and Amhara regions were very high compared to the average of all regions.

The random coefficient model showed that the random effects of religion and exposure to mass media such as radio, TV and newspapers vary across regions in explaining contraceptive use. Further this model implies that there exist considerable differences in contraceptive use among regions and a model with a random coefficient is more appropriate to explain the regional variation than a model with fixed coefficients or empty model with random effects.

5.2 Recommendations

In light of the research findings, the following recommendations are forwarded.

- Better educational level contributes to increased knowledge of contraceptive use; so government and non government organizations should focus on educating women and improving employment opportunities for women as these are effective means of advancing family planning acceptance and increasing the prevalence of contraceptive use.
- Promote family planning by providing better information, supply, access and services about family planning as well as reproductive health, especially in rural areas. It is important that both national and local governments view FP programs through contraceptive use. Strategies that make family planning services available, affordable and accessible to all people, and that offer a wider range of contraceptive methods will have great impact on increasing contraceptive use.
- Enhance information and communication activities regarding family planning services using mass media, family planning workers and health centers across all regions in Ethiopia.
- More family planning workers should be trained so as to increase the number of family planning workers as they contribute to the success of family planning in Ethiopia.
- Since there are variations in contraceptive use across regions, educating women through their religious leaders without violating the norm and cultures of the society is an effective means rising contraceptive use status in all region wise.

- Since this study included only married women as study subjects, it is recommended to undertake a similar research including those sexually active and unmarried women.

5.3 Limitations of the study

Among the limitations of this study two are:

1. Some important variables like discussion about FP, knowledge about the current method, women or husbands approval of family planning and etc were not included in the study due to missing values and non response.

2. Some other important variables such as cost of contraceptives, availability of contraceptives were also not included in the study due to the absence of these variables in the EDHS 2011 survey.

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Appendices

Appendix1. Results of Binary Logistic Regression Analysis SPSS output predicting Contraceptive Use among Married women in the age group 15-19.

Appendix1.1 Results of binary logistic regression Analysis SPSS output predicting Contraceptive use

Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	9324	100.0
	Missing Cases	0	.0
	Total	9324	100.0
Unselected Cases		0	.0
Total		9324	100.0

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

Dependent Variable Encoding

Original Value	Internal Value
Not using	0
using	1

Categorical Variables Codings

		Frequency	Parameter coding									
			(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
REGION	Tigray	943	1.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	Affar	941	.000	1.000	.000	.000	.000	.000	.000	.000	.000	.000
	Amhara	1269	.000	.000	1.000	.000	.000	.000	.000	.000	.000	.000
	Oromiya	1328	.000	.000	.000	1.000	.000	.000	.000	.000	.000	.000
	Somali	635	.000	.000	.000	.000	1.000	.000	.000	.000	.000	.000
	Benishangul-Gumuz	866	.000	.000	.000	.000	.000	1.000	.000	.000	.000	.000
	SNNP	1081	.000	.000	.000	.000	.000	.000	1.000	.000	.000	.000
	Gambela	651	.000	.000	.000	.000	.000	.000	.000	1.000	.000	.000
	Harari	561	.000	.000	.000	.000	.000	.000	.000	.000	1.000	.000
	Addis Ababa	533	.000	.000	.000	.000	.000	.000	.000	.000	.000	1.000
	Dire Dawa	516	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
age	15-19	709	.000	.000	.000	.000	.000	.000				
	20-24	1596	1.000	.000	.000	.000	.000	.000				
	25-29	2264	.000	1.000	.000	.000	.000	.000				
	30-34	1574	.000	.000	1.000	.000	.000	.000				
	35-39	1479	.000	.000	.000	1.000	.000	.000				
	40-44	967	.000	.000	.000	.000	1.000	.000				
	45-49	735	.000	.000	.000	.000	.000	1.000				
Religion	others	243	.000	.000	.000							
	orthodox	3362	1.000	.000	.000							
	protestant	1590	.000	1.000	.000							
	muslim	4129	.000	.000	1.000							
educa	No education	6164	.000	.000								

	Primary	2400	1.000	.000
	secondary and higher	760	.000	1.000
heduca	no education	4815	.000	.000
	primary education	3222	1.000	.000
	secondary and higher education	1287	.000	1.000
Numchild	no child	939	.000	.000
	1 or 2 child	3022	1.000	.000
	three or more child	5363	.000	1.000
hoccup	did not working	180	.000	.000
	agricultureal	6438	1.000	.000
	non agricultureal	2706	.000	1.000
woccup	not working	4810	.000	.000
	non agricultural	2518	1.000	.000
	agicultural	1996	.000	1.000
resid	Urban	2053	.000	
	Rural	7271	1.000	
vistedfp	No	7577	.000	
	Yes	1747	1.000	
knowfpmethod	knows no fp method	6235	.000	
	knows fp method	3089	1.000	
dmch	wants more children	6176	.000	
	wants no children	3148	1.000	
media	no	3955	.000	
	yes	5369	1.000	

Block 0: Beginning Block

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	-1.111	.024	2143.573	1	.000	.329

Block 1: Method = Enter

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	2124.107	34	.000
	Block	2124.107	34	.000
	Model	2124.107	34	.000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	8315.924[a]	.204	.302

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	age			120.479	6	.000			
	age(1)	-.016	.126	.017	1	.896	.984	.769	1.259
	age(2)	-.208	.129	2.575	1	.109	.812	.630	1.047
	age(3)	-.182	.141	1.663	1	.197	.833	.632	1.099
	age(4)	-.263	.145	3.278	1	.070	.769	.578	1.022
	age(5)	-.726	.160	20.496	1	.000	.484	.353	.663
	age(6)	-1.538	.185	69.349	1	.000	.215	.150	.308
	resid(1)	-.778	.096	65.160	1	.000	.459	.380	.555
	vistedfp(1)	.287	.067	18.087	1	.000	1.332	1.167	1.520
	REGION			270.279	10	.000			
	REGION(1)	-.158	.160	.972	1	.324	.854	.624	1.169
	REGION(2)	-.784	.182	18.528	1	.000	.457	.320	.652
	REGION(3)	.849	.149	32.353	1	.000	2.338	1.745	3.132
	REGION(4)	.445	.141	9.906	1	.002	1.560	1.183	2.057
	REGION(5)	-1.583	.256	38.237	1	.000	.205	.124	.339
	REGION(6)	.546	.150	13.218	1	.000	1.727	1.286	2.318
	REGION(7)	.389	.158	6.089	1	.014	1.475	1.083	2.010
	REGION(8)	.401	.169	5.654	1	.017	1.493	1.073	2.078
	REGION(9)	.292	.154	3.617	1	.057	1.339	.991	1.810
	REGION(10)	1.007	.156	41.517	1	.000	2.738	2.015	3.720
	educa			28.946	2	.000			
	educa(1)	.342	.069	24.345	1	.000	1.407	1.229	1.612
	educa(2)	.504	.124	16.561	1	.000	1.656	1.299	2.111
	Religion			53.704	3	.000			
	Religion(1)	.885	.213	17.350	1	.000	2.424	1.598	3.676
	Religion(2)	.480	.209	5.277	1	.022	1.616	1.073	2.434
	Religion(3)	.384	.213	3.249	1	.071	1.468	.967	2.228
	Numchild			69.748	2	.000			
	Numchild(1)	.913	.110	69.531	1	.000	2.492	2.011	3.089
	Numchild(2)	.873	.126	48.027	1	.000	2.395	1.871	3.065
	knowfpmethod(1)	.290	.069	17.715	1	.000	1.337	1.168	1.530
	hoccup			12.606	2	.002			
	hoccup(1)	.293	.257	1.306	1	.253	1.341	.811	2.218
	hoccup(2)	.563	.255	4.879	1	.027	1.756	1.065	2.893

	dmch(1)	.541	.065	69.439	1	.000	1.717	1.512	1.950
	woccup			11.112	2	.004			
	woccup(1)	.211	.066	10.265	1	.001	1.235	1.085	1.405
	woccup(2)	.147	.077	3.588	1	.058	1.158	.995	1.348
	media(1)	.423	.070	36.959	1	.000	1.527	1.332	1.750
	heduca			19.746	2	.000			
	heduca(1)	.295	.067	19.331	1	.000	1.344	1.178	1.533
	heduca(2)	.168	.108	2.410	1	.121	1.183	.957	1.462
	Constant	-3.381	.371	82.855	1	.000	.034		

a. Variable(s) entered on step 1: age, resid, vistedfp, REGION, educa, Religion, Numchild, knowfpmethod, hoccup, dmch, woccup, media, heduca.

Appendix 1.2: Summary of descriptive statistics for Outliers and Influential observations diagnostics for predicting contraceptive use

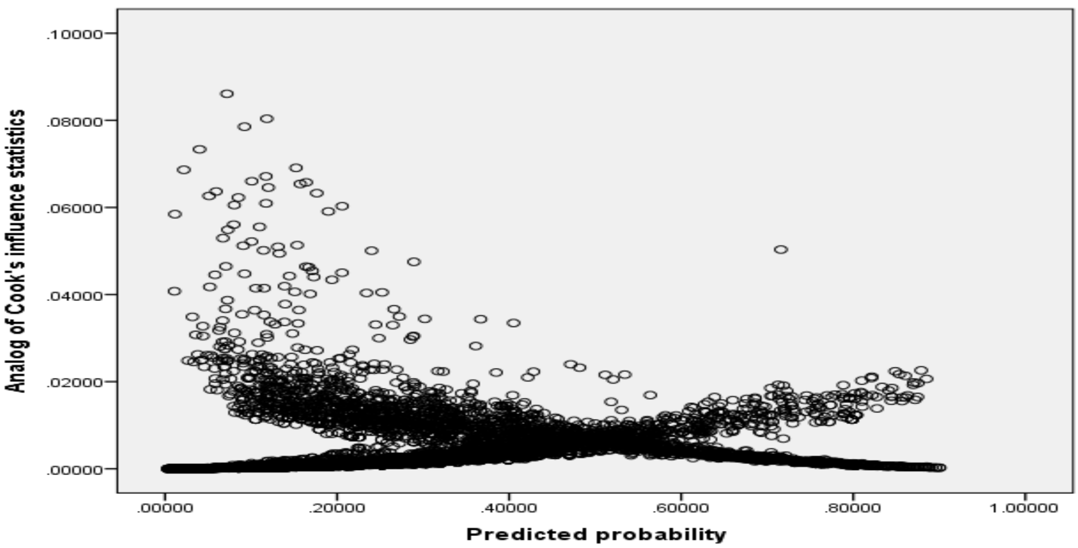
Descriptive Statistics

	N	Minimum	Maximum
Predicted probability	9324	.00324	.90063
Analog of Cook's influence statistics	9324	.00000	.08610
Leverage value	9324	.00024	.02429
DFBETA for constant	9324	-.04231	.06896
DFBETA for age(1)	9324	-.01084	.00974
DFBETA for age(2)	9324	-.01091	.01043
DFBETA for age(3)	9324	-.01080	.01117
DFBETA for age(4)	9324	-.01083	.01166
DFBETA for age(5)	9324	-.01085	.01193
DFBETA for age(6)	9324	-.01105	.01884
DFBETA for resid(1)	9324	-.00935	.00694
DFBETA for vistedfp(1)	9324	-.00346	.00413
DFBETA for REGION(1)	9324	-.01310	.01323
DFBETA for REGION(2)	9324	-.01365	.01969
DFBETA for REGION(3)	9324	-.01397	.00975

DFBETA for REGION(4)	9324	-.01436	.00918
DFBETA for REGION(5)	9324	-.01897	.05202
DFBETA for REGION(6)	9324	-.01412	.00897
DFBETA for REGION(7)	9324	-.01417	.01117
DFBETA for REGION(8)	9324	-.01426	.01531
DFBETA for REGION(9)	9324	-.01352	.00997
DFBETA for REGION(10)	9324	-.01154	.01034
DFBETA for educa(1)	9324	-.00338	.00450
DFBETA for educa(2)	9324	-.00965	.01242
DFBETA for Religion(1)	9324	-.03809	.02335
DFBETA for Religion(2)	9324	-.03689	.02161
DFBETA for Religion(3)	9324	-.03923	.02369
DFBETA for Numchild(1)	9324	-.01001	.00722
DFBETA for Numchild(2)	9324	-.01217	.00876
DFBETA for knowfpmethod(1)	9324	-.00338	.00457
DFBETA for hoccup(1)	9324	-.05960	.04549
DFBETA for hoccup(2)	9324	-.05707	.04746
DFBETA for dmch(1)	9324	-.00366	.00459
DFBETA for woccup(1)	9324	-.00227	.00328
DFBETA for woccup(2)	9324	-.00385	.00435
DFBETA for media(1)	9324	-.00425	.00312
DFBETA for heduca(1)	9324	-.00308	.00362

DFBETA for heduca(2)	9324	-.00693	.01030
Valid N (listwise)	9324		

Fig1.1the scatter plots cook's distance versus predicted probabilities for diagnostic checking



Appendix 2.Results of Multilevel Logistic Regression Analysis STATA output for predicting Contraceptive Use among Married women in the age group 15-49.

Appendix 2.1 Empty with random Intercept Logistic regression Analysis STATA output for predicting Contraceptive Use among Married women in the age group 15-49.

```
  /__    /   ____/   /   ____/
 ___/   /   /___/   /   /___/   11.1   Copyright 2009 StataCorp LP
  Statistics/Data Analysis             StataCorp
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     Special Edition                   College Station, Texas 77845 USA
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Notes:
      1.  (/m# option or -set memory-) 500.00 MB allocated to data
      2.  (/v# option or -set maxvar-) 5000 maximum variables

running C:\Users\Eskezeia\Desktop\Stata11\profile.do ...
unable to change to D:\Research\CRA\
r(170);


. use "C:\Users\Eskezeia\Documents\final.cxx.dta", clear
. xtmelogit ccu|| REGION:,cov(unstr)var
Note: single-variable random-effects specification; covariance structure set to identity

Refining starting values:

Iteration 0:   log likelihood = -4759.0397
Iteration 1:   log likelihood = -4759.0602
Iteration 2:   log likelihood = -4758.9533

Performing gradient-based optimization:

Iteration 0:   log likelihood = -4758.9533
Iteration 1:   log likelihood = -4758.9382
Iteration 2:   log likelihood =  -4758.938

Mixed-effects logistic regression               Number of obs      =      9324
Group variable: REGION                          Number of groups   =        11

                                                Obs per group: min =       516
                                                               avg =     847.6
                                                               max =      1328

Integration points =   7                        Wald chi2(0)       =         .
Log likelihood =  -4758.938                     Prob > chi2        =         .

------------------------------------------------------------------------------
         ccu |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _cons |  -1.247059   .3057705    -4.08   0.000    -1.846358   -.6477602
------------------------------------------------------------------------------

------------------------------------------------------------------------------
  Random-effects Parameters  |   Estimate   Std. Err.     [95% Conf. Interval]
-----------------------------+------------------------------------------------
REGION: Identity             |
                  var(_cons) |   1.017086   .4441632      .4321523     2.39375
------------------------------------------------------------------------------
LR test vs. logistic regression: chibar2(01) =   922.16 Prob>=chibar2 = 0.0000
```

Appendix 2.2 Random Intercepts and Fixed coefficient Logistic regression Model for predicting Contraceptive use among Married women in the group 15-49.

```
. xtmelogit ccu  i.age i.resid i.vistedfp  i.educa i.Religion i.Numchild i.knowfpmethod  i.hoccup i.dmch
> i.woccup i.media i.heduca|| REGION:,cov(unstr)var
Note: single-variable random-effects specification; covariance structure set to identity

Refining starting values:

Iteration 0:   log likelihood = -4203.2906  (not concave)
Iteration 1:   log likelihood = -4197.9367
Iteration 2:   log likelihood = -4188.8253

Performing gradient-based optimization:

Iteration 0:   log likelihood = -4188.8253  (not concave)
Iteration 1:   log likelihood = -4188.3182
Iteration 2:   log likelihood = -4185.4439
Iteration 3:   log likelihood = -4185.3229
Iteration 4:   log likelihood = -4185.3219
Iteration 5:   log likelihood = -4185.3219

Mixed-effects logistic regression               Number of obs      =      9324
Group variable: REGION                          Number of groups   =        11

                                                Obs per group: min =       516
                                                               avg =     847.6
                                                               max =      1328

Integration points =   7                        Wald chi2(24)      =    970.62
Log likelihood = -4185.3219                     Prob > chi2        =    0.0000
```

ccu	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
age						
2	-.0148331	.1256691	-0.12	0.906	-.26114	.2314738
3	-.2049446	.1294251	-1.58	0.113	-.4586131	.0487239
4	-.178595	.1412995	-1.26	0.206	-.4555369	.0983468
5	-.2598632	.1450829	-1.79	0.073	-.5442205	.0244941
6	-.7241231	.1602565	-4.52	0.000	-1.03822	-.4100262
7	-1.534801	.1846541	-8.31	0.000	-1.896716	-1.172886
2.resid	-.7765356	.0960817	-8.08	0.000	-.9648522	-.588219
1.vistedfp	.2883636	.067383	4.28	0.000	.1562954	.4204318
educa						
1	.3444033	.0692233	4.98	0.000	.2087281	.4800784
2	.5086033	.1238446	4.11	0.000	.2658723	.7513342
Religion						
2	.8856628	.2124276	4.17	0.000	.4693124	1.302013
3	.4816068	.2090836	2.30	0.021	.0718105	.8914032
4	.3704553	.2128295	1.74	0.082	-.0466828	.7875934
Numchild						
1	.9124483	.1094633	8.34	0.000	.6979043	1.126992
2	.8681222	.1259091	6.89	0.000	.6213449	1.1149
1.knowfpme~d	.291159	.0688654	4.23	0.000	.1561853	.4261327
hoccup						
1	.3060783	.2562412	1.19	0.232	-.1961452	.8083018
2	.5701442	.2542871	2.24	0.025	.0717506	1.068538
2.dmch	.5459894	.0648849	8.41	0.000	.4188173	.6731615
woccup						
1	.2135482	.0657781	3.25	0.001	.0846256	.3424709
2	.1502667	.0774449	1.94	0.052	-.0015224	.3020558
1.media	.4237822	.0696103	6.09	0.000	.2873485	.5602159
heduca						
1	.2976197	.0671259	4.43	0.000	.1660553	.4291842
2	.1698811	.1080361	1.57	0.116	-.0418658	.3816279
_cons	-3.253477	.4103612	-7.93	0.000	-4.05777	-2.449184

Random-effects Parameters	Estimate	Std. Err.	[95% Conf.	Interval]
REGION: Identity				
var(_cons)	.4609648	.2100498	.1887109	1.126

```
LR test vs. logistic regression: chibar2(01) =   267.09 Prob>=chibar2 = 0.0000
```

```
. xtmelogit,or

Mixed-effects logistic regression               Number of obs      =      9324
Group variable: REGION                          Number of groups   =        11

                                                Obs per group: min =       516
                                                               avg =     847.6
                                                               max =      1328

Integration points =   7                        Wald chi2(24)      =    970.62
Log likelihood = -4185.3219                     Prob > chi2        =    0.0000
```

ccu	Odds Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
age						
2	.9852764	.1238188	-0.12	0.906	.7701731	1.260456
3	.8146925	.1054416	-1.58	0.113	.6321598	1.04993
4	.8364445	.1181892	-1.26	0.206	.6341074	1.103345
5	.771157	.1118817	-1.79	0.073	.5802939	1.024797
6	.4847494	.0776842	-4.52	0.000	.3540844	.6636329
7	.2154986	.0397927	-8.31	0.000	.1500605	.3094726
2.resid	.4599969	.0441973	-8.08	0.000	.3810395	.5553154
1.vistedfp	1.334242	.0899052	4.28	0.000	1.169172	1.522619
educa						
1	1.411148	.0976843	4.98	0.000	1.23211	1.616201
2	1.662967	.2059494	4.11	0.000	1.304568	2.119826
Religion						
2	2.424591	.51505	4.17	0.000	1.598894	3.676691
3	1.618673	.338438	2.30	0.021	1.074452	2.438549
4	1.448394	.3082609	1.74	0.082	.9543901	2.1981
Numchild						
1	2.490412	.2726087	8.34	0.000	2.009537	3.08636
2	2.382433	.29997	6.89	0.000	1.86143	3.049262
1.knowfpme~d	1.337977	.0921403	4.23	0.000	1.169043	1.531324
hoccup						
1	1.358089	.3479983	1.19	0.232	.8218929	2.244094
2	1.768522	.4497123	2.24	0.025	1.074387	2.91112
2.dmch	1.726316	.1120118	8.41	0.000	1.520163	1.960425
woccup						
1	1.238063	.0814374	3.25	0.001	1.088309	1.408423
2	1.162144	.0900021	1.94	0.052	.9984787	1.352637
1.media	1.527729	.1063457	6.09	0.000	1.332889	1.75105
heduca						
1	1.34665	.0903951	4.43	0.000	1.180638	1.536004
2	1.185164	.1280405	1.57	0.116	.9589984	1.464667

Random-effects Parameters	Estimate	Std. Err.	[95% Conf.	Interval]
REGION: Identity				
sd(_cons)	.6789439	.1546886	.4344087	1.061132

```
LR test vs. logistic regression: chibar2(01) =   267.09 Prob>=chibar2 = 0.0000
```

Appendix 2.3 Result of Random Coefficient Logistic regression Model for predicting Contraceptive Use in the age group 15-49

```
. xtmelogit ccu i.age i.resid i.vistedfp  i.educa i.Religion i.Numchild i.knowfpmethod i.hoccup i.dmch i.
> woccup i.media i.heduca|| REGION: media  vistedfp  Religion,cov(unstr)var

Refining starting values:

Iteration 0:   log likelihood = -4172.6786  (not concave)
Iteration 1:   log likelihood = -4161.0022  (not concave)
Iteration 2:   log likelihood = -4160.9137

Performing gradient-based optimization:

Iteration 0:   log likelihood = -4160.9137  (not concave)
Iteration 1:   log likelihood = -4154.7925  (not concave)
Iteration 2:   log likelihood = -4152.2461  (not concave)
Iteration 3:   log likelihood = -4145.2014  (not concave)
Iteration 4:   log likelihood = -4141.7546  (not concave)
Iteration 5:   log likelihood = -4139.1643  (not concave)
Iteration 6:   log likelihood = -4138.0837
Iteration 7:   log likelihood = -4135.3378
Iteration 8:   log likelihood = -4133.9541
Iteration 9:   log likelihood =  -4133.301  (not concave)
Iteration 10:  log likelihood = -4133.0462
Iteration 11:  log likelihood = -4132.9232
Iteration 12:  log likelihood = -4132.9199
Iteration 13:  log likelihood = -4132.9188  (not concave)
Iteration 14:  log likelihood = -4132.9187
Iteration 15:  log likelihood = -4132.9187
Iteration 16:  log likelihood = -4132.9187

Mixed-effects logistic regression               Number of obs      =      9324
Group variable: REGION                          Number of groups   =        11

                                                Obs per group: min =       516
                                                               avg =     847.6
                                                               max =      1328

Integration points =   7                        Wald chi2(24)      =    640.76
Log likelihood = -4132.9187                     Prob > chi2        =    0.0000
```

ccu	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
age						
2	-.0298871	.1266672	-0.24	0.813	-.2781503	.218376
3	-.2271257	.1304687	-1.74	0.082	-.4828397	.0285884
4	-.2019685	.1424923	-1.42	0.156	-.4812484	.0773114
5	-.2737467	.1464466	-1.87	0.062	-.5607768	.0132834
6	-.7481601	.1615695	-4.63	0.000	-1.06483	-.4314897
7	-1.568881	.1857791	-8.44	0.000	-1.933001	-1.20476
2.resid	-.7073317	.0982851	-7.20	0.000	-.899967	-.5146964
1.vistedfp	.2923026	.082638	3.54	0.000	.1303352	.4542701
educa						
1	.3187072	.0698821	4.56	0.000	.1817409	.4556735
2	.4864145	.1254747	3.88	0.000	.2404886	.7323404
Religion						
2	.9158826	.2661567	3.44	0.001	.3942251	1.43754
3	.421017	.3545883	1.19	0.235	-.2739632	1.115997
4	.1647662	.4624541	0.36	0.722	-.7416271	1.071159
Numchild						
1	.930733	.1101524	8.45	0.000	.7148383	1.146628
2	.9038881	.1269567	7.12	0.000	.6550576	1.152719
1.knowfpme~d	.2775081	.0694122	4.00	0.000	.1414627	.4135535
hoccup						
1	.242895	.2621008	0.93	0.354	-.270813	.7566031
2	.4989011	.2603261	1.92	0.055	-.0113286	1.009131
2.dmch	.5231176	.0655132	7.98	0.000	.3947141	.6515211
woccup						
1	.188297	.0662127	2.84	0.004	.0585225	.3180714
2	.0822788	.0782486	1.05	0.293	-.0710857	.2356433
1.media	.5250268	.2081681	2.52	0.012	.1170248	.9330287
heduca						
1	.2754099	.067667	4.07	0.000	.1427849	.4080348
2	.1771354	.1092324	1.62	0.105	-.0369562	.391227
_cons	-2.97653	.4053382	-7.34	0.000	-3.770978	-2.182082

Random-effects Parameters	Estimate	Std. Err.	[95% Conf.	Interval]
REGION: Unstructured				
var(media)	.3791052	.1388339	.1849428	.7771094
var(vistedfp)	.0179795	.0118407	.0049454	.0653661
var(Religion)	.1946412	.0665427	.0995935	.3803981
var(_cons)	.4835806	.2996381	.1435635	1.628897
cov(media,vistedfp)	-.0309082	.0329176	-.0954255	.033609
cov(media,Religion)	-.191762	.070644	-.3302217	-.0533024
cov(media,_cons)	.0610879	.1472744	-.2275646	.3497404
cov(vistedfp,Religion)	-.0208545	.0235383	-.0669888	.0252798
cov(vistedfp,_cons)	.0528551	.0511309	-.0473596	.1530698
cov(Religion,_cons)	-.2218565	.1369502	-.4902739	.0465609

LR test vs. logistic regression: chi2(10) = 371.90 Prob > chi2 = 0.0000

Note: LR test is conservative and provided only for reference.

```
. xtmelogit,or

Mixed-effects logistic regression               Number of obs      =      9324
Group variable: REGION                          Number of groups   =        11

                                                Obs per group: min =       516
                                                               avg =     847.6
                                                               max =      1328

Integration points =   7                        Wald chi2(24)      =    640.76
Log likelihood = -4132.9187                     Prob > chi2        =    0.0000
```

ccu	Odds Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
age						
2	.9705551	.1229375	-0.24	0.813	.757183	1.244055
3	.7968207	.1039602	-1.74	0.082	.6170287	1.029001
4	.8171207	.1164334	-1.42	0.156	.6180114	1.080378
5	.7605247	.1113763	-1.87	0.062	.5707655	1.013372
6	.4732365	.0764606	-4.63	0.000	.3447863	.6495407
7	.2082782	.0386937	-8.44	0.000	.1447132	.2997638
2.resid	.4929578	.0484504	-7.20	0.000	.4065831	.597682
1.vistedfp	1.339508	.1106943	3.54	0.000	1.13921	1.575023
educa						
1	1.375349	.0961122	4.56	0.000	1.199303	1.577235
2	1.626474	.2040813	3.88	0.000	1.27187	2.079943
Religion						
2	2.49898	.6651203	3.44	0.001	1.483234	4.210327
3	1.52351	.5402189	1.19	0.235	.76036	3.052611
4	1.179117	.5452876	0.36	0.722	.4763382	2.918762
Numchild						
1	2.536368	.2793869	8.45	0.000	2.043856	3.14756
2	2.469185	.3134795	7.12	0.000	1.925253	3.16679
1.knowfpme~d	1.319837	.0916128	4.00	0.000	1.151958	1.512182
hoccup						
1	1.274935	.3341614	0.93	0.354	.7627591	2.131025
2	1.646911	.4287338	1.92	0.055	.9887353	2.743216
2.dmch	1.68728	.1105391	7.98	0.000	1.48396	1.918457
woccup						
1	1.207192	.0799314	2.84	0.004	1.060269	1.374474
2	1.085759	.0849591	1.05	0.293	.9313821	1.265723
1.media	1.690504	.351909	2.52	0.012	1.124147	2.542197
heduca						
1	1.31707	.0891223	4.07	0.000	1.153482	1.50386
2	1.193793	.1304009	1.62	0.105	.9637183	1.478794

Random-effects Parameters	Estimate	Std. Err.	[95% Conf.	Interval]
REGION: Unstructured				
sd(media)	.6157152	.1127419	.4300497	.8815381
sd(vistedfp)	.1340877	.044153	.0703237	.2556679
sd(Religion)	.4411816	.0754142	.3155844	.6167642
sd(_cons)	.6953996	.2154431	.3788978	1.276282
corr(media,vistedfp)	-.374374	.3369417	-.8215408	.3579549
corr(media,Religion)	-.7059361	.1579441	-.9044454	-.2561169
corr(media,_cons)	.1426727	.3526198	-.5093338	.6906174
corr(vistedfp,Religion)	-.3525279	.3613397	-.8265174	.4139671
corr(vistedfp,_cons)	.5668438	.4038373	-.4802969	.9477393
corr(Religion,_cons)	-.7231367	.1841984	-.9316749	-.1561568

LR test vs. logistic regression: chi2(10) =   371.90   Prob > chi2 = 0.0000

Note: LR test is conservative and provided only for reference.