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Factors associated with dropouts from contraceptive use among women in Ethiopia

By

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ABSTRACT

This study focuses on the socio-economic and demographic determinants of dropout in contraceptive use in Ethiopia using data collected in Ethiopia Demographic and Health Survey EDHS (2005). The survey collected information from a total of 2962 married women of the reproductive age group (between 15 and 49 years), out of which 1343 women were considered in this study.

Descriptive, Logistic regression and Multilevel statistical techniques were used for data analysis using socio-economic and demographic back ground variables. The relative importance of the explanatory background variables were examined using the logistic regression model. The multilevel model reflects the existence of significant variations in the mean effects of the predictor of currently dropout from contraceptive use at regional level. Dropout and currently contraceptive using are treated as the outcome of a dichotomous dependent variable in the model.

The result of descriptive analysis indicated that contraceptive dropout rate was 61.7%. High rates of dropout from contraceptive use was observed in Amhara (77%) followed by Afar (76%). Among the main reasons for dropping out from contraceptive use are, the need for more children (65.2%) followed by health concern (56.6%).

Based on univariate and multivariate result six factors (predictors) associated with contraceptive dropout were selected. These predictors were generic reasons such as husband's disapproval, difficulty in getting modern contraceptive methods, misinformation about religious aspects of family planning, etc , region, type of place of residence, accessibility of family planning lessons through media, access to health facility and number of children alive. All these factors play a pivotal role on dropout in contraceptive use. Thus, we can conclude that there are inherent weaknesses in family planning program that need to be addressed.

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ACRONYMS

CMR: -	Child Mortality Rate
CPR: -	Contraceptive Prevalence Rate
CPR: -	Contraceptive Prevalence Rate
ECSPR: -	Ethiopian Central Statistic Population Report
EDHO: -	Ethiopian District Health Office
EDHS: -	Ethiopian Demographic Health Survey
EDU: -	Education
ETR: -	Ethiopia Trend Report
FP: -	Family Planning
HFP: -	Heard Family Planning last 12 month
IMR: -	Infant Mortality Rate
IUD: -	Intra Uterine Devices
LR: -	Likelihood Ratio
MC: -	Modern Contraceptive
MMR: -	Maternal Mortality Ration
MOFED: -	Ministry of Finance and Economic Development
MOH: -	Ministry of Health
NLC: -	Number of Living Children
NPPOE: -	National Population Policy of Ethiopian
OCP: -	Oral contraceptive Pill
RH: -	Reproductive Health
RLD: -	Reason of Last Discontinuation
SFP-	Studies in Family Planning
UN: -	The United Nations
UNFPA: -	United Nations Fund for Population Activates
VFP: -	Visited Family Planning worker
VHF: -	Visited Health Facility
WB: -	The World Bank
WBPRS: -	World Bank Family Planning Service

CHAPTER ONE
INTRODUCTION

1.1 Background of the study

The world population is increasing from time to time at unprecedented speed. From day to day it is becoming a global concern as many countries in many parts of the world face the difficulty of sustaining their population. The situation in Ethiopia is much worse than in most African countries. Ethiopia is the third populous country in Africa with a population of 73,918,505 in the mid 2008. The population is growing rapidly at the rate of 2.6 percent per year. At this rate of growth the country will reach 100million in the next 15 years according to Ethiopia Central Static Population Report (Haile, 2004).

In most developing countries in general, and in sub Sahara in particular, the problem of population growth and reproductive health challenges include; high maternal mortality, high population growth rate, total fertility rate and much unmet need for family planning in the world. The situation in Ethiopia is still much worse than most African countries Ethiopia Trend Report (ETR; 2007). In spite of the fact that family planning service delivery facilities and other supplies have increased much in number in the country, a significant portion of the Ethiopian population is still living in abject poverty.

The total fertility, in case of Africa was 6.2 children per women; it was 6.8 children per women in Ethiopia (United Nation (UN), 1991). In Ethiopia at present, according CSA (2001), 5.4 Children per women, which is still very high when compared with most other African countries Central statistic Agency and World Bank Family Planning Services (CSA, 2001; WB, 1995). The contraceptive prevalence rate is about 23% among women of the reproductive age. (In some reports even much lower figures than this have been reported). The Maternal Mortality Rate (MMR) (700-1000/10,000), the Child Mortality Rate (CMR) (84.5/1000) and the Infant Mortality Rate (IMR) (96.8/1000) are also among the highest figures in Africa. The population growth rate is as high as 2.5%. (Ministry of Health (MOH); 2002/03, EDHS; 2005).

The aforementioned facts indicate the low level of health service utilization in the country including Reproductive Health (RH)/ Family Planning (FP) services. Health service utilization can be defined as the number or proportion of the population using health services; which in turn can be related to the number or proportion in need of the services. Given the services are available, the factors influencing the utilization of health services broadly include need, geographic accessibility, acceptability and affordability to the consumers.

It is clear that the problem of population growth is imminent in this country. A look at the agricultural sector reveals that, even though agriculture is the backbone and life blood of the majority of the population, immense emphasis by all the concerned bodies is not given as is supposed to be. In the period between 2001/02-2004/05, it registered an average growth rate of 2.5% while per capita agricultural production rose by 2.1 % (MOFED, 2005). As result, it has become incompatible with the 2.46 % population growth rate.

The shortage of food coupled with the poor health condition (only 46% or less of the population has currently access to health service) has largely contributed to the present rate of undernourishment and the prevailing high level of infant, child and maternal mortality National Population Policy of Ethiopia (NPPoE, 2005). Infact, infant mortality rate stands at 97 per 1000 population and that of children under-five is 140 per 1000 population while maternal mortality is 871 per 100,000 live births. Among the major factors contributing to the rate of maternal mortality are illegal abortions which are unsafe and teenage pregnancy (CSA, 2005).

In addition to the above mentioned list of misery, Africa's economic problem is so tangled that it is not in a position to pace with the already increasing population growth. Nevertheless, in this regard, the major concern in not over-population but the gap created between the ever increasing population and the basic needs of the society. Population pressure has made living a costly business. Besides, it has to lead to dire consequences by

depleting natural resources as activities such as deforestation for fuel wood and arable land has denuded the land, more and more forest land is being cleared for settlement and agriculture (MOFED, 2005).

Generally, the major reasons that attributed to contraceptive dropout in developing countries like Ethiopia according to United Nations Fund for Population Activates (UNFPA, 1999) and Bandrage (1997) are poverty, lack of access to health care, side effects of contraceptives, disapproval of partner, needs for more effective method, and socio-economic conditions.

To alleviate the ill of economy, the government of Ethiopia has set new economic strategies in which the issue of population is given due emphasis. Thus, cognizant of the problem in order to ameliorate the increasing difficulties by population pressure, the government has adopted a population policy in 1993. The policy has set as its objective increasing contraceptive prevalence rate from the 1990 level of 4% to 44% by the year 2015 (CSA.2005). As is pronounced in the policy, to bring fertility reduction, the introduction of an efficient programme of family planning is necessary. Lessons drown from countries such as Indonesia, Brazil and Bangladesh have proved that through strong family planning effort, it is possible to bring fertility reduction and promote the health of the women and children and thereby reducing the high maternal, infant and child mortality.

However, the contraceptive prevalence rate in Ethiopia has not only been low but has not shown a significant rise compared to other African countries such as Kenya and Zimbabwe. Thus, investigating the factors that attribute to the high rate of contraceptive discontinuation is of paramount importance since the current high fertility combined with the relative declining mortality causes a high rate of population growth. Consequently, the present study focuses on factors contributing to the very low level of contraceptive prevalence rate (CPR) in the county.

This study also attempts to identify causes/ reasons of discontinuation from contraceptive use in Ethiopia. It is hoped that the findings will enable policy makers and planners to identify target groups and focuses on area for a possible intervention.

1.2. Statement of the problem

Contraceptive use, as a proximate determinant of fertility, plays an important role in reducing fertility; and at times contraceptive prevalence has been used to evaluate the effect of family planning programs (Boukier, 1985). It is also a major proximate determinant within marriage and is believed to be the cause for the fertility transition of many developing countries (Bongarts, Laphan and Mauldin cited by Abdullahi et al. 1990). Since Ethiopia is one of the developing countries characterized by high fertility, wide use of contraceptives becomes an indispensable way out to move from such high level of fertility to low level. Contraceptive use, however, is the consequence of contraceptive acceptance, method choice, continuation, switching and failure. As contraceptive use increases and becomes a more established behavior, prevalence is no longer a sufficient marker of program success (Jejeebhoy, 1991).

Current contraceptive prevalence is the outcome of annual acceptance and the discontinuation rate. Jain (1996) has suggested both can be influenced by quality of service and demand factors and proposed that contraceptive continuation is more important than acceptance in increasing contraceptive prevalence. Jain identifies access to contraceptive method choice as a key element of services quality, that is likely to increase contraceptive continuation and prevalence.

According to the results of the national family and fertility survey of Ethiopia on overall knowledge of contraception, 88% of women covered by the survey reported to have heard of at least one method of family planning (CSA, 2005). Out of these, 16% were between ages 15-19, 27% were between ages 25-29, the same 27% were between ages 40-44, and only 14% were the oldest age group reported ever used (EDHS, 2005). Family planning information is largely disseminated through radio with limited dissemination through television or the print media. For example, 29% of women heard

about family planning on radio compared with 11% of women who got family planning information from television and 8% who got such information from newspapers or magazines (EDHS, 2005).

It is often argued that parents in traditional societies want a big family for several reasons. Children are seen as valuable to peasant households as labour force in rendering services and directly participating in production activities. Because of this fact people in these traditional societies remained reluctant to accept Modern Contraceptive MC/FP (Mueller, 1978 and Boserup, 1985).

Furthermore, the oldage security value of children in peasant societies also prohibits contraceptive use. Arnold et. al. (1975) in his study in southeast Asian countries and USA-Hawii state have revealed that couples who want children for current economic and future security reasons (rural and urban lower class) tend to have higher actual and desired fertility than those who want children primarily for psychological reasons (urban middle class). This indicates that, oldage security value of children also works against contraceptive adoption by the poor majority of the population in the developing countries. Bandarage (1997) and Shane (1997) have also indicated that couples under uncertain and insecure social and economic conditions (people who are illiterate, living in rural areas) in peasant societies take high fertility as an efficient strategy to strengthen their social and economic positions and hence are reluctant to use contraceptives. In addition, Shane (1997) and Bandarage (1997) have also pointed out that the majority of people in developing countries are reluctant to use modern contraceptives even when they have a widespread knowledge to the benefits obtainable from family planning due to many social, economic, and cultural reasons. This indicates that couples in developing countries like Ethiopia are unable to regulate fertility because of various social, economic, cultural, psychological and demographic reasons. Thus, at present development programs that focus on women empowerment as a poverty reduction strategy are accepted as a quick fix solution of population growth and economic development United Nations Fund for Population Activates (UNFPA, 1999).

So, why do people neglect contraception although they have knowledge, what are the factors responsible for such a high percentage of current drop out in contraceptive use (61.7%) according to this result?

1.3. Objective

The major objective of this study is to assess contraceptive dropout rate and various factors leading to dropout in Ethiopia.

1.4. Specific objective

The specific objectives of this study are:-

- To understand factors for discontinuation in contraceptive use.
- To investigate regional differences in discontinuation in contraceptive use.
- To determine the prevalence of contraceptive dropout among women.

1.5 Applications of the results

The result of the study may enable family planning workers and policy makers to enhance the awareness of the society about factors that affect the dropout in contraceptive uses. It can also be used:

- To focus on improving the status of women that will lead to decrease in dropout in contraceptives use.
- Help to develop specific programs for each region aimed at decreasing dropout in contraceptives use.
- Be used as a source of information to other researchers in the future.

1.6 Limitation of the study

The data used here being secondary may have a number of limitations on the outcome of this study.

- The study is based on currently dropout in contraceptive use at the time of survey. It did not include those who dropout previously and then started using contraceptive again.

- The important variables related to the subject under study have a large number of missing values and thus, the sample size for analysis is significantly reduced.
- Lack of literature in our country related to the subject under study.
- In the analysis of data using multilevel logistic regression, a student version of LISREL software is used which is restricted to handle few explanatory variables. Because of this, only a limited number of predictor variables are used in multilevel logistic regression analysis.

1.7 Definition of terms

In order to overcome problems which might arise in defining certain key concepts by different scholars, within the context of the present study the following working definitions are adopted:

- **Dropout**:

Any married women between the age of 15-49 years who was using contraceptive before the survey and stops using contraceptive without shifting to any other modern or traditional method.

- **Non-users:**

a. those who discontinue use because they have no current need for contraception due either for desire to have pregnancy or became pregnant due to contraceptive failure,

b. Those women who are having infrequent intercourse, (either because they are separated from their husband, or their husbands are away) and those who have reached menopause and consider themselves infertile.

- **Unmet need:-** refers to the contraceptive needs of currently married, fecund and non pregnant women who intend to limit or space pregnancy but not practicing.
- **Limiters:-** refers to currently married, fecund and non pregnant women who do not want any more children.
- **Spacers:-** refers to currently married, fecund and non pregnant women who want to delay their next birth at least for two years.
- **Fecund:-** refers to the physiological capacity to reproduce.

CHAPTER TWO
LITERATURE REVIEW

2.1. Overview

Modern methods of contraception are very effective in preventing pregnancy as compared to traditional contraceptives. It has been observed that women who use modern methods of contraception discontinue using contraceptive without adopting an alternate method, or to traditional and less effective methods, which lead to unwanted pregnancy.

Comparative studies conducted in DHS surveyed countries during 2000-2005 have shown that, despite the relatively high total fertility rate in Africa, total fertility rate is the lowest in Lesotho (3.5) and the highest in Chad (6.3) compared to Ethiopia (3.5). Indeed, in some African countries (e.g. Kenya, Mali, Togo and Uganda) the projected declines in fertility rate equal or exceed those in lower fertility areas in which family planning services and information are already much better established; such as North Africa and Latin America (Sinding, 1994).

Furthermore, the implementation of voluntary family planning programs has been the principal policy initiative pursued by governments in the developing world that wish to reduce population growth. The level and patterns of contraceptive use are critical variables in changing fertility, and causal inference about fertility conditions and changes in them must be supported by some empirical knowledge of what causes people to regulate contraception voluntarily by applying contraceptives. Thus, based on the literature, overview of some possible determinants of women's dropout in contraceptive use will be highlighted in the following section.

2.1.1 Contraceptive prevalence rate

In contraceptive prevalence, the percentage of currently married women of reproductive age that use a contraceptive method has been 10 percent around the world in the early 1960's to an estimated 55 percent in the 1990's (Bongaarts et.al., cited in Nork, 1993). The prevalence levels are higher in the industrialized than in the developing world (75 %

versus 51 %). The 2005 EDHS indicate that the discontinuation rate in contraceptive use is highest among those who take oral pills (61%) and in the lowest among users of injectables (32%). Among different reasons of contraceptive discontinuation, the desire to become pregnant is the most prominent reason (30%) followed by health concerns (26%).

Najama (2005) found that in Pakistan, one-third of the women stop using contraceptives and the discontinuation is highest among users of oral pill, condoms and injectables. The main reason of discontinuation was side effects. In Bangladesh, the discontinuation of condom and traditional methods like periodic abstinence is the consequence of accidental pregnancy (Nancy, 2000). A cross sectional study using Life table continuation rates for Intra Uterine Devices (IUD), Condoms Withdrawal, and periodic abstinence carried out in Pakistan indicates 12 months continuation rate for female methods is 64.6%, 76.9% for couple methods and 72.6% for all methods. The 12 months continuation rates for oral pills were 55.2%, injectables 47.8% and 80% for IUD users. There was no difference in continuation rate during first year of use and the use thereafter as depicted by similar rates of annual continuation rates and 12 months Life table continuation rates. The older women with high parity and who have been married longer have longer continuation rates. Women who live in urban areas, educated women and women with higher economic status have higher continuation rates than rural women of lower socioeconomic status. The reasons for discontinuation of modern methods have been identified as side effects, methods switching, desired pregnancy and other personal reasons (Miller, P.C. et.al, 1997). Similar findings have been reported in a retrospective study of women's records in Alexandria (Egypt), which indicates significant predictors of discontinuation as side-effects, health concerns, and types of contraceptive method use (Mahdy and El-Zeiny, 1999).

2.1.2 Demographic factors

Various studies have identified different demographic variables as influential in the dropout in contraceptive use. These variables among others include age, number of living children and lack of exposure to the risk of pregnancy.

It has been observed that women are less likely to use contraceptives at the youngest and oldest ages of the reproductive life span. This pattern is interpreted partly as it may reflect desire for more children among young women, and effects of declining frequency of intercourse, perception of low risk of becoming pregnant or traditional views that favor large families at old ages (Njogu, 1991). A number of studies show that age is an important determinant of contraceptive use. A study in Japan shows the desire to have no more children was high among women aged between 30-40 (63 %) followed by those aged 35-39 (33 %). The same study also showed that the percentage of non-users who desire to have children varied inversely with ages ranging from 15-24 (25%) to that of 40-49 (3%) (Kobayash, 1986). In Paraguay lower use of contraceptives was observed between the age 15-19 and 40-44, although two-thirds of these women did not desire to become pregnant (Richards et.al, 1988).

A study made by Sayed et.al (1985) reveals that the percentage of contraceptive dropout increases with age especially for those approaching the end of child bearing period. Furthermore, the percentage of spacers and limiters also varies greatly due to age. Studies in Ethiopia based on 2000 EDHS data indicated that unmet need for spacing is higher among younger women, while unmet need for limiting is higher among older women. Those aged 20-49 are significantly less likely to have an unmet need for spacing as compared to women aged15-19. However, this difference (though significant for each of the different age groups) becomes less prominent with age. In contrast, young women (15-19) are much less likely to have an unmet need for limiting than older women (25+). Indeed, women of age 35 and over are almost five times as likely to have an unmet need for limiting as women of age 15-19 (Antenane, 2002). Studies made by Odile (1987) reveal that in sub-Saharan Africa the majority of currently married fecund women who were practicing contraception either wanted more children or desired a family size greater than they had (or both). Hence, it can be implied that contraception among all currently married fecund women is practiced primarily for spacing purposes (Odile, 1987). In Mali, among the non-users who were exposed to the risk of conception, 10.9 percent did not use contraception because they wanted a child soon (Bongaarts et.al, 1990).

According to Sayed et.al (1985), the need for family planning is positively related with the number of surviving children. The percent in need increases with the number of living children. For instance in Egypt, out of those women with no living children, only 3 percent were in need of family planning while 35 percent of the women with seven or more living children were in need . In the case of Mali the same result was observed. The intention among non-users to start contraception soon rose from 7.7 percent for those with no children to 14.7 percent for those with four surviving children (Bongaarts et.al, 1990). Similar results were recorded by Sathara et.al (1984). For African and Asian countries, some studies have found relatively highest contraceptive use mostly among women with four or more children (Sathara and Chictambara, 1984). With regard to Ethiopia, a study based on 2005 EDHS indicated contraceptive use is highest among currently married women with one or two children (17%) and lowest among women with no children (12%).

2.1.3 Socio-economic factors

According to Daniel S. et.al (1995), among the socio-economic factors that may affect contraceptive dropout, place of residence, religion, work status/occupation, education, husbands or other relatives disapproval, lack of knowledge about contraceptive method, and actual or perceived fear of sideeffects are considered to be important.

It is assumed that urban women use contraceptives more than their rural counterparts. The difference between urban and rural prevalence is highest in sub-Saharan Africa where the rate is more than twice as high among urban than rural married women (Curtis and Neitzel, 1996). As Sayed et.al (1995) noted, among one quarter of all currently married women in Egypt who were in need of family planning, the proportion of rural women is somewhat larger than urban women (28% vs 21%). Data which are supposed to represent countries of the developing world from three continents also indicate that the need for family planning services is higher in rural areas compared to urban areas (29% against 23%) (Westoff et.al (1989)). In Ethiopia, there is a significant variation in the use of contraception by place of residence. Thus, use of modern family planning is about four times higher in urban than in rural areas (42% versus 11%) CSA and ORC Macro (2006).

Ethiopian DHS 2000 survey indicates that among currently married women unmet need for spacing is 22% while unmet need for limiting is 14% .Total unmet need is higher in rural areas than urban area which is 37% and 25%, respectively (CSA and ORC Macro, 2000).

A study conducted in Awassa town and other urban areas in 2002 revealed that unmet need for family planning in Awassa town was 23.6% of which 13% for spacing and 10.5% for limiting of child birth and unmet need in other urban was 40% of which 32.7% for spacing and 7.4% for limiting birth (Sita,2003).

According to a study by Assefa Hailemariam et.al, 55.7% of women in rural areas are defined as having unmet need. Most of these are seen wish space to future pregnancies 44.8%; a minority seeks to limit childbearing (10.9%). These urban-rural differential could be explained by the fact that couples living in urban areas are most likely to be near to health facilities, more educated and have better knowledge of family planning matters, and more likely to be decision makers on fertility regulations than those in rural areas. Among the most important socio-cultural factors inhibiting contraceptive use in most of the developing countries, culture, religion, and husband or other relatives disapproval play greater role.

The roles of religion and culture as determinants of fertility have been a subject of considerable discussion in fertility literatures. Every social group has a characteristic culture, complex of belief, attitudes, values and social controls. The cultural and religious background of a given community has a powerful effect on health seeking behavior in general, and contraceptive use in particular. In contraceptive practice the strongest opposition was come from the Catholic Church, which prohibits utilization of artificial contraception in the 1930s and Islamic religion followed it HailemariamA (2000) and Ethiopia District Health Office (EDHO) (2005). A study conducted in Bangladesh revealed that the percentage of current users of contraceptive methods among Muslims was significantly lower than their non-Muslim counterparts (30.2% and 36.3%, respectively) (Shahid et.al, 1993)). According to the 2000 demographic and health survey

(DHS) Ethiopia report, a highly significant proportion of females reported that in most cases religious leaders oppose the use of MC. Ethnicity and religion are also determinant factors in the use of contraception (Ethiopia Demographic and Health Agency (EDHA,2000)).

A study conducted in Indonesia regarding making decision about contraception shows that an estimated 27.8 percent of dropout in contraceptive use in Jakarta could have been prevented if husbands disapproval of contraceptive use had been eliminated (Joesoef et. al, 1988).

Though the degree is much higher, findings of a study from urban Sudan also provide a similar result. That is, husband's opposition is reported as 57.1 percent (Swar El-dahab, 1993). In Malawi and Egypt, husband's opposition contributes 10.4 and 2.2 percent respectively (Bonga arts and Mouldin 1989 and 1990).

In Ethiopia, a 1999 study conducted in a remote community in the south reported that because of male dominance in the culture, women would be forced to bear large number of children, and this was a major obstacle in the fertility regulation decisions by women (EDHS, 2000).

Fatalistic reason or philosophical reason also constitutes a significant proportion for the non-use of contraceptives. It is not surprising to hear such reasons as: '' it is up to God to decide the number of children one may have''. In the cases of urban Sudan 36.3 percent, Mali 8.3 percent and Egypt 11.3 percent of exposed non-users reported fatalistic reasons of non-use (Swar El-dahab, 1990).

In a study conducted among women of reproductive age group in Zimbabwe by the World Bank (WB), modern contraceptive use and fertility regulation have significant association with increased educational attainment, although at low level of education (less than 6 years) there was no clear association between education and use of modern contraception. It was reported among women who have completed primary school (seven

years of education) that the powerful effect of education becomes apparent. Similarly, women who have completed secondary school and above were about twice as likely to use modern contraceptive methods as women who did not complete primary schooling (WB,1995).

Many studies in developing countries highlighted the importance of women's employment to their contraceptive behavior and fertility. For instance, the increasing status of women represented by education and employment decreases the number of children in Kazakhistan (Alsawi, and Adamchak, 2000). Women who were self employed and those who were employees had significantly higher probabilities of using contraception than those who were not employed in Zaire (Shapiro et.al 1994). Working women are more likely to have direct access to financial resources, be in contact with people other than their immediate family and generally be more knowledgeable about the world outside the home (Kishor, and Neitzal, 1996). This may affect their fertility and contraceptive behavior.

In a study conducted in Uganda, modern contraceptive use was independently and positively associated with formal education. The study reported that in urban areas women with at least a secondary education had significantly higher odds of contraceptive use than non-educated women. The effect of education on use of contraceptives was even more striking in rural areas. Compared with woman with no education, those with at least primary schooling or higher had nearly five times the odds of contraceptive use and those with secondary or higher had almost ten times the odds of contraceptive use (Charles et.al, 2003).

In Ethiopia, the situation is not different from what is mentioned above. A study conducted in southern Ethiopia reported broad association of literacy with current and intended use of contraception (Dennis et.al, 1999). A study conducted in Gondar town showed that there was a positive association in contraceptive use with increased educational status. The study showed that the relative percentages of contraceptive use

increases from 33.7% to 41% among primary and secondary schooling and 52.5% among higher educated women (Yigezaw, 2000).

Disseminating information through the mass media increases awareness about new technologies, ideas on specific things and so on. Indeed, broadcast through the radio and television, and printed materials such as newspapers, leaflets may bring change in individual's attitude towards accepting modern life style. In particular they can serve to disseminate information on family planning. Having information and knowledge about modern contraceptive methods is mandatory to utilize the service (ETR, 2007).

A study conducted in Africa identified that a high proportion of women (74.3%) who belonged to various clubs and associations that discussed health related topics were knowledgeable and contraceptive users, which indicated that information exchanges through discussion in such organization increase the desire for modern family planning (Kaona et.al, 1996).

In most developing countries, especially in Sub-Saharan Africa, promoting family planning through radio and television is an important means of raising awareness, improving knowledge, and motivating use of modern contraceptive methods (ETR, 2007). In most countries regular exposure to mass media has a positive effect on use of contraceptive. In relation to Ethiopia, a study based on 2005 EDHS indicated that family planning information is largely disseminated through radio with limited dissemination through television or print media. For example, 29 percent of women heard about family planning on radio compared with only 11 percent of women who get family planning information from television and 8 percent who got such information from newspapers or magazines.

Another study conducted in Jimma zone, Ethiopia, in 2003 identified that a significant proportion of clients were obliged to use methods other than their choices. The study showed that 21.1% of clients were using oral contraceptive pill (OCP) without being their choice, and about 13.1% of the clients were not totally given the chance to choose the FP

method. A tangible increment in contraceptive dropout was found by a study conducted in Bangladesh, which revealed that introducing household provision of injectibles in early 1977 helped raise CPR from 7% to 20%, the introduction of tubectomy services in 1978 helped to increase the prevalence by an additional 10%, and household insertion of IUDs in 1981 elevated the prevalence yet further, which showed that provision of different methods can enhance utilization of modern contraception (Shahid and Nitai,1993).

The other factor cited in most writings for dropout in contraceptive use is actual or perceived fear of side effects such as fear of damage to health and infertility. Such women constitute 42.8 percent of exposed dropout in Sudan, 17 percent in Egypt and 3.8 percent in Mali (Swar El-dahab, 1993)

Among the finger counted studies conducted on the area, a study made by Najma (2005) in north west rural region of Peshawar Afghanistan, using descriptive analysis reveals that among different reasons of dropout from contraceptive use, the main reason for dropout was "health concern" (45.52%) followed by "worry about sideffect" (40%) and the third most common reply was "wanted more children" (34.5%). Najma also identifies various variables related with dropout from contraceptive use using cross tabulation and multilevel logistic regression. Such variables are demographic, socio-cultural, service availability, numbers of living children, religious beliefs, distance traveled from home to the health care facility, women desire to have another child and message through media. All the above mentioned variables except age, education and access to health facility were found to have a significant effect on women to dropout from contraceptive use.

Another study made by Fengyu et.al, (1999) in Northern India using descriptive analysis, multilevel logistic and multinomial descriptive time hazard model, found significant effects from socio economic, age, parity, travel time, method access, method type and source on reason specific risks on contraceptive discontinuation. According to the study, place of residence, household size, living children, side effects, health concerns, service facilities, source of contraceptive information do have significant effect on discontinuation. But women's age and education significantly lowers the probability of

discontinuation. Fengyu also observed significant random effects at both community and individual levels for some variables. Moreover, he found significant correlation between unobserved random factors and discontinuation at individual level suggesting the consideration of other factors, such as previous contraceptive experience and biological factors as potential source for the shared unobserved heterogeneity.

Some of studies revised and presented in this chapter used descriptive statistics, bivariate analysis and logistic regression. Likewise in our study we will descriptive statistics and logistic regression to see the effects of those factors on contraceptive use; and multilevel logistic regression to see the regional difference on dropout in contraception use and differential effects of selected factors on dropout of contraceptive use at region levels.

CHAPTER THREE
DATA AND METHODOLOGY

3.1 Data

The data used in these study are obtained from the 2005 Ethiopian Demographic and Health Survey (EDHS) conducted by CSA. The survey collected information from 1343 women aged 15-49 on the current level of fertility, mortality, family planning behavior, background characteristics of respondents and other variables. The survey was intended to provide estimates of key population and heath indicators, including fertility and mortality for the country as a whole. This study also uses the data to identify individual and regional level determinants of contraceptive drop out using multilevel techniques.

3.2 Definition of variables

The response (dependent) variable is binary and describes whether a woman is a contraceptive dropout or contraceptive user. The predictor variables/factors of interest in this analysis include characteristics of women and family planning facilities. These variables have been chosen to reflect the factors that might be expected to be associated with dropout in contraceptive use in Ethiopia. For the characteristics of the family planning facilities, some of the variables are selected as indirect explanatory variables. As noted by Mensch et al. (1994), demographers have long been interested in developing indicators from survey data that assess, even if indirectly, the efficacy of family planning programs.

3.2.1 The Response Variable

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

$$Y_i = \begin{cases} 1, & \textit{if the } i^{th} \textit{ individual is a dropout from contraceptive use} \\ 0, & \textit{otherwise} \end{cases}$$

3.2.2 Predictor Variables/factors

The predictor variables which are expected to influence dropout in contraceptive uses are all categorized and grouped under three major classes: Demographic characteristic and socio-economic characteristic. An important modeling consideration for continuous covariates is their scale in the logit. When a logistic regression model contains a continuous independent variable, interpretation of the estimated coefficient will depend on how it is entered into the model and the particular units of the variable. If the assumption that the logit is linear in the covariate is not met, then grouping and use of dummy variables could be considered. In this study, dichotomizing some of the continuous variables was made to have a sound interpretation of predictor variables.

Table 1: Description of Variables included in the Analysis

❖ **Response Variable**

Variable	Representation of variable	Categories
Pattern of use	Y	1=Currently dropout from contraceptive use 0 =currently using contraceptive

❖ **Predictor Variables**

1. Demographic variables

Variables	Representation of variable	Categories
Age of women(AGE)	X_1	1=15-19, 2=20-34, 3=35-49
Number of living children(NLC)	X_2	0= three or more, 1= 1 or 2 children, 2= no children

2. Socio- economic Variables

Variables	Representation of variable	Categories
Women's Education(EDU)	X_3	0=Secondary and above, 1= Primary education, 2=No education
Religion(REL)	X_4	1= Orthodox, 2= Protestant,

		3=Muslim, 4= Others
Place of Residence(PLR)	X_5	1=Urban, 2=Rural
Heard FP on radio in the last 12 months(HFP)	X_6	0= Yes, 1=No
Visited by FP worker in the last 12 months(VFP)	X_7	0= Yes, 2=No
Visited a health facility in the last 12 months(VHF)	X_8	0= Yes, 1=No
Region(REG)	X_9	1=Tigray, 2=Afar, 3=Amhara, 4=Oromia, 5=Somali, 6=Ben-gumuz, 7=SNNP, 8=Gambela, 9=Harari, 10=Dire Dawa, 11=Addis Ababa

3. Proximate Variable

Variable	Representation of variable	Categories
Reason of last discontinuation	X_{10}	0= Want more children, 1= Health concern, 2= Want more effective method, 3= Side effect 4= Others

3.3 Methods for data Analysis

3.3.1. Logistic Regression analysis

3.3.1.1 Introduction

Logistic regression can be used to predict a response variable on the basis of continuous, discrete, dichotomous, or a mix of any of these predictor variables: to determine the percent of variance in the response variable explained by the predictor variables; to rank the relative importance of predictor variables; to assess interaction effects; and to understand the impact of covariate control variables. Its close relationship to log-linear

analysis of contingency table and linear discriminant function analysis made the logistic model more popular than the other related models.

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, no multicollinearity and sampling adequacy.

In the terminology of Logistic Regression Analysis the odds of a success is defined to be the ratio of the probability of a success to the probability of a failure. Hence if p is the true success probability the odd of a success is $p/(1-p)$.

Let Y be $n\times1$ a dichotomous outcome random vector with categories 1 (currently dropout from contraceptive use) and 0 (currently contraceptive use). Let X be an n x (p+1) denotes the collection of p-predictor variables of Y, i.e.

$$X = \begin{bmatrix} 1 & x_{11} & \cdots & x_{p1} \\ 1 & x_{12} & \cdots & x_{p2} \\ . & \cdots\cdots & & . \\ . & \cdots\cdots & & . \\ 1 & x_{1n} & \cdots & x_{pn} \end{bmatrix}$$

X is called the regression matrix and without the leading column of 1s, is termed as predictor data matrix. Then, the conditional probability that the i^{th} individual is a dropout from contraceptive use given the individual characteristics $\mathbf{X}_i$ is given by:

$$p_i = P(Y_i = 1 \mid x_i)$$

In logistic regression analysis, it is assumed that the explanatory variables affect the response through a suitable transformation of the probability of the success. This transformation is a suitable link function of p_i, and is called the logit-link, which is defined as:

$$\text{logit}(p_i) = \log\left(\frac{p_i}{1-p_i}\right) \quad \text{.....(1)}$$

The transformed variable logit (p_i) is related to the explanatory variables as:

$$\text{logit}(p_i) = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \ldots + \beta_p X_{pi} = X_i'\beta. \quad \text{.....(2)}$$

where $\beta = (\beta_0, \beta_1, \beta_2, \ldots, \beta_p)'$ are the model parameters and $X_i = (x_{0i}, x_{1i}, \ldots x_{pi})'$ with $x_{0i} = 1, i = 1, \ldots, n$

The above relation can be given as

$$p_i = P(Y_i = 1/x_{1i}, x_{2i}, \ldots, x_{pi}) = \frac{e^{X'_i\beta}}{1+e^{X'_i\beta}} \quad \text{.....(3)}$$

With further rearrangement we obtain the odds of success

$$\text{Odds}(Y_i = 1) = \frac{pi}{1-pi} = e^{X'_i\beta} \quad \text{.....(4)}$$

The above three equations give suitable representations of log-odds, the success probability, and odds, respectively. Indeed, these representations facilitate interpretations of parameter estimates.

3.3.1.2 Parameter Estimation

The maximum likelihood and non-iterative weighted least squares are the two most competing estimation methods used in fitting logistic regression model (Hosmer-Lemeshow, 1989; Greene, 1991, Collet, 1991 and others). When the assumption of normality of the predictors does not hold, the non-iterative weighted least squares method is less efficient (Maddala, 1992). In contrast, the maximum likelihood estimation method is appropriate for estimating the logistic (logit) model parameters due to this less restrictive nature of the underlying assumptions (Hosmer-Lemeshow, 1989). Hence, in

this study the maximum likelihood estimation technique is applied to estimate the parameters of the model. The likelihood is

$$L = \prod_{i=1}^{n} P_i^{y_i} (1-P_i)^{1-y_i} = \prod_{i=1}^{n} \left(\frac{e^{X'_i\beta}}{1+e^{X'_i\beta}} \right)^{y_i} \left(\frac{1}{1+e^{X'_i\beta}} \right)^{1-y_i} \quad \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Taking the natural logarithm of both sides yields

$$\ln L = \sum_{i=1}^{n} y_i \ln \left(\frac{e^{X'_i\beta}}{1+e^{X'_i\beta}} \right) + \sum_{i=1}^{n} (1-y_i) \ln \left(\frac{1}{1+e^{X'_i\beta}} \right) \quad \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

Our objective is then to get an estimator $\hat{\beta} = (\hat{\beta}_o, \hat{\beta}_1, \ldots\ldots, \hat{\beta}_p)'$ of β which maximizes the likelihood function expressed in equation (6). We differentiate lnL with respect to each component of the parameters and set the resulting (p+1) equations to zero. Since the likelihood equations are nonlinear in the parameters, the solution to this non-linear equation can be obtained by using the Newton-Raphson iterative maximum likelihood estimation method that expresses $\hat{\beta}$ at the $(u+1)^{th}$ cycle of the iteration as

$$\hat{\beta}_{u+1} = \hat{\beta}_u + \left(X' \hat{V}_u X \right)^{-1} X R_u$$

where u=0,1,2,3,..... and $\hat{V}$ is a diagonal matrix with its diagonal elements $\hat{V} = \text{diag}[\hat{p}(1-\hat{p}_i)] = \text{cov}(Y)$ and $R_u = Y - \hat{P}$. Finally, $\hat{\beta}$ is the resultant maximum likelihood estimator of β with residual R_u (Collet, 1991; Greene, 1993). The Newton-Raphson method usually converges to the maximum of the log-likelihood in just a few iterations unless the data are especially badly conditioned (Greene, 1993).

Thus, the fitted values for the probability of success is given by $\hat{p}_i = \frac{\exp(X'_i \hat{\beta})}{1+\exp(X'_i \hat{\beta})}$. All the parameter estimates $\hat{\beta}_O, \hat{\beta}_1, \ldots\ldots, \hat{\beta}_p$ and estimates of $p_i = P[Y_i = 1 | x_i]$ for each subject were computed using the SPSS and LISREL software.

3.3.1.3 Interpretation of the coefficients of the logistic regression model

The estimated coefficients for the predictor variables represent the slope or rate of change of a function of the outcome variable per unit of change in the predictor variable

(Hosmer-Lemeshow, 1989). Thus interpretation involves two issues: (i) determining the functional relationship between the outcome variable and the predictor variable and (ii) appropriately defining the unit of change for the predictor variable (Hosmer-Lemeshow, 1989).

The estimated logistic coefficients $\hat{\beta}_j$'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. Hence, the odds of being in the category of interest for the ith subject, namely $\frac{\hat{p}_i}{(1-\hat{p}_i)} = e^{X'_i\beta} = e^{\hat{\beta}_j}$ represents the multiplicative factor by which the odds change for every unit change in x_i controlling for the other predictor variables, where $X_i = (0, 0\ldots 1, 0\ldots.0)$ with the 1 in the jth position. For predictor variables having L levels (L $\geq$2), interpretation was made by making one of the L-levels as a reference category.

3.3.1.4 Variable Selection

The number of variables that would be included in the model should be of the minimum possible that is parsimonious and deliver optimum information. In this study the variable selection process begins with a univariate analysis of each variable. A systematic relation or association between each predictor variable with the response variable was made before the final model was selected. A univariate logistic regression and a likelihood ratio (LR) chi-square test were also employed to examine the importance of each predictor variables to the outcome variable.

The separate effects of each predictor variable in explaining the outcome variable was made by postulating the null hypothesis that H_0: $\beta_i=0$ against the alternative H_1: $\beta_i \neq 0$ for at least one i (i=1, 2, …, p). The significance test for each coefficient in the model was done using Wald chi-square ($\left[\frac{\hat{\beta}_i}{s.e(\hat{\beta}_i)}\right]^2$) which is distributed as chi-square with 1 degree of freedom) and the Likelihood Ratio Test. The Wald statistic, however, has

some undesirable properties for large coefficients as the standard error is often inflated lowering the Wald statistic (chi-square) value and leading to type II errors. On other hand, Agresti (1996) suggested that the likelihood ratio (LR) test is more reliable for small sample sizes than the Wald test. Accordingly, this study used the Wald and/or LR statistic to assess the significance of each predictor variable.

Upon completion of the univariate analysis, predictor variables for the multivariate analysis will be selected in such a way that any variable whose univariate test has a p-value less than 0.25 was considered as a candidate for the multivariate model (Hosmer Lemeshow, 1989).

For multivariate model, a stepwise method in which variables are selected either for inclusion or exclusion from the model in a sequential fashion based solely on statistical criteria was used. There are two main versions of the stepwise procedure: (a) forward selection with a test for backward elimination and (b) backward elimination followed by a test for forward selection. The study employs stepwise forward likelihood ratio procedure in order to select the predictor variables that will have joint impact on the outcome variable.

The final decision on the inclusion of each predictor variable will be made on the examination of the Wald statistic for the variable, and comparing each estimated coefficient of the particular variable on the multiple regression model with the univariate estimate of the model containing only that predictor. Variables that do not contribute to the model based on these criteria were eliminated and a new model will be fitted. The new model will be compared with the old model through the LR test. Also, the estimated coefficients for the remaining variables will be compared to those from the full model. In view of this (deletion, refitting and/or verifying) will be performed. Having obtained a model that contained the essential variables, the need to include interaction term in the model will be assessed by creating the appropriate product of the variables in question. Assessment of the significance of each interaction term will be

made using a LR test. Interactions that will not contribute to the improvement of the model will be discarded and the model with main-effects was maintained.

3.3.1.5. Goodness of- fit Assessment of the model

A variety of statistical tests exist for determining the significance or goodness-of-fit of a logistic regression model. Some of these measures are: Likelihood Ratio Test; Hosemer-Lemeshow Goodness-of-Fit Test (assesses the fit of the model by comparing the observed and expected frequencies); and Nagelkerke Pseudo R^2.

The computed value of likelihood ratio (LR) test, which is defined as $-2[L_0 - L_1]$ (where L_0 and L_1 are the maximized log-likelihoods under the null (H_o) (logistic model with constant only) and alternative (H_1) (logistic model with p- predictor) hypothesis, respectively) will be used to test the null hypothesis that the p-coefficients for the covariates in the model are not important in explaining the response variable against the alternative that at least one of the covariates is important. Under the null hypothesis, the LR is distributed as $\chi_p^2(\alpha)$ and hence if LR exceeds that of $\chi_p^2(\alpha)$, we reject the null hypothesis and conclude that at least one of the p-covariates included in the model are important in explaining the variation in the outcome variable.

However, for this analysis Hosmer-Lemeshow Chi-Square test of goodness of fit is recommended for overall fit of a logistic regression model (Agresti, 1990).The test statistic is formulated under the following hypothesis.

H_o: the model fit the data Vs H_1: not H_0

The test divides subjects into deciles by ordering the existing data by the level of their predicted probabilities. This means the data are first ordered from least likely to have the event to most likely for the event. The observed and expected numbers of events are computed from each group. Then the statistic is computed from observed (O_k) and expected (E_k) frequencies:

$$\hat{C} = \sum_{k=1}^{10} \frac{(O_k - E_k)^2}{V_k} \sim \chi^2(8) \quad \ldots\ldots (7)$$

where O_k = observed number of events in k^{th} group

E_k = expected number of events in k^{th} group and

V_k = a variance correction factor for the k^{th} group

$$V_k = n_k' \bar{P}_k\left(1-\bar{P}_k\right), \quad \text{(8)}$$

$$\bar{P}_k = \sum_k^{n_k'} \frac{m_k \hat{p}_k}{n_k'}, \quad \text{(9)}$$

where n_k' is the number of covariate patterns in the K^{th-} group, $\bar{P}_k$ is the average estimated probability, $\hat{p}_k$ is the estimated probability of the k^{th} group and m_k is the number of success in the k^{th} group.

If the p-value of the Hosmer-Lemeshow goodness of fit test statistic is greater than, for example, 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.

3.3.1.6. Model Adequacy

Once a model is fitted to the observed values of a binary response variable, a thorough examination of the extent to which the fitted model provides an appropriate description of the observed data is a vital aspect of modeling process. The fitted logistic regression model may be inadequate due to a particular observation, termed **outliers**, or observations, termed **influential** values that have an undue impact on the conclusions to be drawn from the analysis and presence of complete or near compete linear dependencies among the predictor variables. Some of the statistical techniques which are employed to examine the adequacy of a fitted model include: detection and treatment of outliers, influence and multicollinearity diagnostics.

i. Detection and Treatment of Outlier(s)

An observation that is surprisingly distant from the remaining observations in the sample is called **outlier.** Such values may occur as a result of measurement errors, employing a faulty experimental procedure or just an extreme manifestation of natural variability. For binary data, an outlier occurs as a result of **transcription errors,** that is, when the response variable equals unity and the corresponding fitted probability is near zero or vice versa (Collet, 1991). Since fitted probabilities near zero or one will occur when the linear predictor has a large negative or a large positive value, outliers can only occur at observations that have extreme values of the explanatory variables.

Some of the statistical methods that are used for detecting the presence and extent of influence of outlier(s) are: unstandardized residuals, $y_i - \hat{p}_i$; the Pearson or standardized $\chi^2 = \sum_{i=1}^{n} \frac{(y_i - \hat{p}_i)^2}{\hat{p}_i(1-\hat{p}_i)}$ or goodness-of-fit statistics (the change in model deviance if the case is removed) and deviance (D) which is defined as $\pm 2\sqrt{\ln\left[\frac{y_i}{\hat{p}_i}\right]^{y_i}\left[\frac{1-y_i}{1-\hat{p}_i}\right]^{1-y_i}}$. Of these methods, the study employs the standardized residuals for identifying potential outliers. Hence, using the customary significance level of 0.05, the presence of outliers is signaled if the standardized or Pearson residuals lie outside the range of the interval (-3, +3). Whenever outliers are identified, their effect on the results of the analysis can be assed by re-analyzing the data after omitting them. If essentially the same inferences are drawn from the data both with and without the outliers, one need not be concerned about their presence. On the other hand, if the outliers do affect model-based inferences, the decision on how to regard them (to include them, to revise the model or to omit them) should not only be made on statistical grounds but also through closer subjective and objective examination of the data and its other essential ingredients.

ii. Influence Diagnostics

An observation is said to be influential if its omission from the data set results in substantial changes to certain aspects of the fit of the logistic regression model. In most

cases, it is more important to pay attention to outliers that are influential than those that are not. Although outliers may also be influential observations, an influential observation need not necessarily be an outlier. In particular, an influential observation that is not an outlier will occur when the observation distorts the form of the fitted model to such an extent that the observation itself has a small residual.

Some of the statistical methods used in influence diagnostics are: Leverage statistic; ($\hat{h}_{ii}$, which is called the diagonal elements of the matrix H = X (X 'X)$^{-1}$X ' i.e. $\hat{h}_{ii}$= dig{ $\hat{p}_i(1-\hat{p}_i)$} for i=1,2,...,n called the "hat" matrix); DFBETA (the change in the logistic regression parameter estimates when the observation is deleted); Cook's distance ($C_i = \frac{r_i \hat{h}_{ii}}{p(1-\hat{h}_{ii})}$ where r_i is the Pearson residual, $\hat{h}_{ii}$, the leverage of case i and p is the number of parameters in the model); and the change in the Pearson statistic ($\chi^2 = \sum_{i=1}^{n} \frac{(y_i - \hat{p}_i)^2}{\hat{p}_i(1-\hat{p}_i)}$ or goodness-of-fit statistics (-2log-likelihood)).

The study uses Cook's distance to assess the overall impact of an observation on the estimated parameter vector $\hat{\beta}$. Hence, any point for which Cook's distance greater than one will be considered as influential. Besides, the specific impact of an observation on the regression coefficients will be checked using the DFBETA statistic. DFBETA greater than unity will be considered as outlier(s) for critical variables in the model.

3.3.2. Multilevel models

3.3.2.1. Introduction

Multilevel analysis is a methodology for the analysis of data with complex patterns of variability, with a focus on nested sources of variability. The best way to the analysis of multilevel data is an approach that represents within-group as well as between-group relations within a single analysis, where 'group' refers to the units at the higher levels of the nesting hierarchy. Very often it makes sense to use probability models to represent the variability within and between groups, in other words, to conceive the unexplained variation within groups and the unexplained variation between groups as random variability. For example, a study of contraceptive dropout women within regions means

that not only unexplained variation between individuals (women), but also unexplained variation between regions is regarded as random variable. This can be expressed by statistical models called random coefficient models. Multilevel analysis is an approach to the analysis of such data including the statistical techniques as well as the methodology of how to use these.

3.3.2.2 Multilevel logistic Regression

3.3.2.2.1 Introduction

A multilevel logistic regression model as a hierarchical model, can account for lack of independence across levels of nested data (i.e., individuals nested within groups). Conventional logistic regression assumes that all experimental units are independent in the sense that any variable affecting dropout from contraceptive use has the same effect in all groups. Multilevel modeling relaxes this assumption and allows the effects of these variables to vary across groups.

Multilevel logistic regression can be employed in the simplest case without explanatory variables, (usually called empty model) and also with explanatory variables by allowing only the intercept term or both the intercept and slopes (regression coefficients) to vary randomly. Mainly the normal (multivariate normal) distribution is assumed for the varying coefficients. To keep the discussion on multilevel logistic regression models simple and taking into account the data to be analyzed in this study, we concentrate on the case of two-levels. The extensions to the case of three or higher levels is straight forward (Snijders and Bosker, 1999).

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) and a random sample of n_j level-one units (individuals) within group j, j=1,2,...,N. 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 two outcomes are supposed to be coded 0 and 1: 0 for 'failure', 1 for

'success'. The total sample size is denoted by $M = \sum_{j=1}^{N} n_j$. 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 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, plus some individual-dependent residual, ε_{ij}:

$$Y_{ij} = P_j + \varepsilon_{ij} \quad \ldots\ldots (11)$$

The residual term is assumed to have mean zero and variance,

$$\text{var}(\varepsilon_{ij}) = P_j(1 - P_j) \quad \ldots\ldots (12)$$

Since the outcome variable is coded 0 and 1, the group sample average is the proportion of successes in group j given by

$$\hat{P}_j = \frac{1}{n_j} \sum_{i=1}^{n_j} Y_{ij} \quad \ldots\ldots (13)$$

$\hat{P}_j$ is an estimate for the group-dependent probability P_j. Similarly, the overall sample average is the overall proportion of successes, $\hat{P}$, and is given by:

$$\hat{P} = \frac{1}{M} \sum_{j=1}^{N} \sum_{i=1}^{n_j} Y_{ij} \quad \ldots\ldots (14)$$

This is an estimate for the overall probability of success, P.

3.3.2.2.2 Heterogeneous Proportion

For the proper application of multilevel analysis, the first logical step is to test heterogeneity of proportions between the groups. Here we present two commonly used test statistics. To test whether there are indeed systematic differences between the groups, the well-known chi-square test for contingency table can be used. In this case the chi-square test can be written as

$$X^2 = \sum_{j=1}^{N} n_j \frac{(\hat{P}_j - \hat{P})^2}{\hat{P}(1 - \hat{P})} \quad \ldots\ldots (15)$$

This statistic follows approximately the chi-squared distribution with ($N-1$) degrees of freedom. The approximation is valid if the expected number of successes 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, 1990, p. 246). This condition will not always be satisfied, and the chi-squared test then may lack power. For a large number of groups, the null distribution of X^2 can be approximated by a normal distribution with the correct mean and variance (McCullagh and Nelder, 1989).

Another test of heterogeneity of proportion was proposed by Commenges and Jacqmin (1994). The test statistic is

$$Z = \frac{\sum_{j=1}^{N}\left\{n_j^2(n_j\hat{P}_j - \hat{P}_.)^2\right\} - M\hat{P}_.(1-\hat{P}_.)}{\hat{P}_.(1-\hat{P}_.)\sqrt{2\sum_{j=1}^{N} n_j(n_j-1)}} \quad \text{.......... (16)}$$

The statistic, Z, tends to follow a standard normal distribution. Thus, large values of this statistic are indication of heterogeneous proportions.

In the statistic Z the numerator contains a weight of n_j^2 whereas the chi-squared test uses a weight n_j. This shows that the two tests combine the groups in different ways. Hence, when the group sizes n_j are different, it is possible that the two test lead to different outcomes. The 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 (Snijders and Bosker ,1999).

The discussion now turns to some special cases of the two level models.

3.3.2.2.3 Two level empty logistic regression model

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. This model only contains random groups and random variation within groups. It can be expressed as a model where the dependent variable is

the sum of a general mean, Φ_{oo}, a random effect at the group level, U_{oj}, and a random effect at the individual level ε_{ij} given as :

$$Y_{ij} = \beta_{0j} + \varepsilon_{ij}. \quad \ldots\ldots (17)$$

$$\beta_{0j} = \Phi_{oo} + U_{oj} \quad \ldots\ldots (18)$$

Substitution of (18) in to (17) yields the model;

$$Y_{ij} = \Phi_{oo} + U_{oj} + \varepsilon_{ij} \quad \ldots\ldots (19)$$

$$i=1,2,\ldots..,n;\ j=1,2,\ldots,N.$$

Log-odd of events is a linear model i.e.

$$\text{Log}\left(\frac{p_{ij}}{1-p_{ij}}\right) = \text{logit}\,(p_j) = \Phi_{oo} + U_{oj} \quad \ldots\ldots (20)$$

Assumption:

- $\varepsilon_{ij} \sim$ iid N $(0, \sigma^2_e)$,i.e. level one variance,
- $U_{oj} \sim$ iid N $(0, \omega_{oo})$),i.e. level two variance,
- Cov $(\varepsilon_{ij}, U_{oj}) = 0$, i.e. U_{oj} and ε_{ij} are independent for all i and j,
- Φ_{oo} is the fixed effect of mean response for groups,
- $U_{oj} + \varepsilon_{ij}$ random effect of the model,
- $Y_{ij} \sim$ Bernoulli (p_{ij}), with $p_{ij} = P(Y_{ij} = 1)$.

In the context of multilevel modeling, (17) is variously called the empty, random intercept, or variance component model. It is important because it provides the basic partition of the variability in the data between the two levels.

An important statistic from the empty model is the intra-class correlation coefficient (ICC):

$$\text{ICC} = \frac{\omega_{00}}{\omega_{00} + \sigma^2_e} \quad \ldots\ldots (21)$$

which is the proportion of total variance that is accounted for at the group level if there is no between-group variance. If the ICC is zero, then a hierarchical model is unnecessary, assuming the model is correct. The ICC can also be interpreted as the correlation between level units randomly paired within groups (Snijdors and Bosker, 1999).

3.3.2.2.4 Two level random intercept and fixed coefficient logistic regression model

Consider an explanatory variable measured at individual level. A first step towards modeling between group variability is to let the intercept vary between groups but the regression coefficient of the X_{ij} is constant. This allows us to estimate the unexplained variability in the intercept across the level two units.

The level-1 model with P explanatory variable X_{ij} is given by:

$$Y_{ij} = \beta_{oj} + \beta_{1j}X_{1ij} + \beta_{2j}X_{2ij} + \ldots\ldots + \beta_{pj}X_{pij} + \varepsilon_{ij} \quad \ldots\ldots(22)$$

The logit link function, the log-odds, has a normal distribution in the population of groups and is expressed by:

$$\mathrm{Log}\left(\frac{p_{ij}}{1-p_{ij}}\right) = \mathrm{logit}\,(p_j) = \beta_{oj} + \beta_{1j}X_{1ij} + \beta_{2j}X_{2ij} + \ldots\ldots + \beta_{pj}X_{pij} \quad \ldots\ldots(23)$$

For the level-2 model, to reduce the unexplained variability we assume the intercept term to vary among groups, β_{oj}. That is, the varying intercept is the sum of general mean ϕ_{oo} and random effect at group level, U_{oj}.

$$\beta_{oj} = \phi_{oo} + U_{oj} \quad \ldots\ldots(24)$$

Further, we assume fixed regression coefficients for each explanatory variables i.e, $\beta_{1j} = \phi_{1o}$, $\beta_{2j} = \phi_{2o}$, …….,$\beta_{pj} = \phi_{po}$.. Putting equation (24) into equation (23), we get:

$$\mathrm{logit}\,(p_j) = \phi_{oo} + \sum_{m=1}^{P} \beta_{mj} X_{mij} + U_{0j}$$

$$= \phi_{oo} + \sum_{m=1}^{P} \Phi_{mo} X_{mij} + U_{oj} \quad \ldots\ldots (25)$$

Assumption:

- From model (25), $\phi_{oo} + \sum_{m=1}^{P} \Phi_{mo} X_{mij}$ is fixed effect of the model, because the coefficients are fixed (i.e. not stochastic),
- $U_{oj} + \varepsilon_{ij}$ random effect of the model (from(22)),
- ε_{ij} ~iid N (0, σ^2_e),i.e. level one variance,
- U_{oj}~ iid N (0, ω_{oo})), i.e. level two variance.

3.3.2.2.5 Two level random intercept and random coefficient logistic regression model

The unexplained variability in single-level multiple regression analysis is just the variance of the residual term. Variability in multilevel data, however, has a more complicated structure. This is related to the fact that several populations are involved in multilevel modeling: one population for each level. Explaining variability in a multilevel structure can be achieved by explaining variability between individuals but also explaining variability between groups; if there are random slopes as well as random intercepts at the group level, one could try to explain the variability of slopes as well as intercepts.

Suppose that there are P level one explanatory variables X_{1ij}, X_{2ij}... X_{pij}. At the within-group level, i.e., for the individuals, the model then is a regression model with P variables,

Logit $(p_{ij}) = \beta_{cj} + \beta_{1j}X_{1ij} + \ldots + \beta_{pj}X_{pij}$ ..... (26)

where all the regression coefficients β_{oj}, β_{1j}, ..., β_{pj} are assumed to vary randomly between the groups. Thus, the varying regression coefficients are given by

$\beta_{0j} = \Phi_{oo} + U_{oj}$

$\beta_{1j} = \Phi_{1o} + U_{1j}$

$\beta_{2j} = \Phi_{2o} + U_{2j}$

$\beta_{3j} = \Phi_{3o} + U_{3j}$

. . .

. . .

$\beta_{pj} = \Phi_{po} + U_{pj}$ .....(27)

Substituting of all equations of (27) into (26) and rearrangement of terms then yields the model:

$$\text{Logit } (p_{ij}) = \Phi_{oo} + \Phi_{1o}X_{1ij} + \Phi_{2o}X_{2ij} + \ldots\ldots + \Phi_{po}X_{pij} + U_{1j}X_{1ij} + U_{2j}X_{2ij} + \ldots\ldots U_{pj}X_{pij} + U_{oj}$$

$$= \Phi_{oo} + \sum_{m=1}^{P}\Phi_{mo}X_{mij} + \sum_{m=1}^{P}U_{mj}X_{mij} + U_{oj} \quad \ldots\ldots (28)$$

Assumption:

- $\Phi_{oo} + \sum_{m=1}^{P} \Phi_{mo} X_{mij}$ is a fixed effect of the model,
- $\varepsilon_{ij} \sim$ iid N (0, σ^2_e), i.e. level one variance,
- $\sum_{m=1}^{P} U_{mj} X_{mij} + U_{oj}$ is a random effect of the model,
- $$\begin{bmatrix} U_{oj} \\ U_{1j} \\ . \\ . \\ . \\ U_{pj} \end{bmatrix} \sim \text{iid N} \left[\begin{pmatrix} 0 \\ 0 \\ . \\ . \\ . \\ 0 \end{pmatrix}, \begin{pmatrix} \omega_{oo}, \omega_{o1}, \ldots\ldots\ldots\ldots, \omega_{op} \\ \omega_{1o}, \omega_{11}, \ldots\ldots\ldots\ldots, \omega_{1p} \\ \ldots\ldots\ldots\ldots\ldots\ldots \\ \ldots\ldots\ldots\ldots\ldots\ldots \\ \ldots\ldots\ldots\ldots\ldots\ldots \\ \omega_{po} \ldots\ldots\ldots\ldots\ldots \omega_{pp} \cdot \end{pmatrix} \right]$$, for allj .....(29)

  where the diagonal ω_{oo}, ω_{11}... ω_{pp} are variances of group intercepts and group slopes. Off diagonals are covariance between intercepts and slopes.
- U_{oj}, U_{lj}.....U_{pj} are uncorrelated with ε_{ij}.
- The random coefficients are assumed independent between groups, but may be correlated within groups.

The U_{oj} .....U_{pj} are measures of the unique deviation of the intercept of cach group form the overall intercept.

3.3.2.2.6. Parameter Estimation

Parameter estimation in multilevel logistic regression models is more complicated than in other models. But a typical implementation of multilevel modeling involves the use of empirical Bayesian maximum likelihood (EB/ML) methods. The EB refers to the fact that level-1coffecinets for individual groups can be calculated using Bayesian shrinkage estimators following estimation of the other model parameters. The estimation of level-2 fixed effects are also EB estimates (Burstein, et al, 1989). The ML refers to the fact that the methods generate maximum likelihood estimate of variance components.

Consider the random coefficient logistic regression model given by

$$\text{Logit}\,(P_{ij}) = \Phi_{oo} + \sum_{m=1}^{P} \Phi_{mo} X_{mij} + \sum_{m=1}^{P} U_{mj} X_{mij} + U_{oj} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (30)$$

where (U_{0j}, U_{1j}, ..., U_{pj}) in most applications are assumed to have a multivariate normal distribution with mean zero and covariance matrix D as given by equation (29).

3.3.2.2.7 Testing the significance of parameters

The null hypothesis

$$H_0: \Phi_{m0} = 0 \qquad \text{Vs} \qquad H_1: \Phi_{m0} \neq 0 \qquad m = 0, 1, 2 \ldots p$$

Can be tested by using the test statistic

$$Z = \frac{\hat{\Phi}_m}{S.E(\hat{\Phi}_m)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (31)$$

This, for large samples, has an approximate N (0, 1) distribution if H_0 is true.

3.3.2.2.8 Goodness of fit test

The deviance-based test, or likelihood ratio test, is a general principle for statistical testing. In applications of a hierarchical linear model, this test is mainly used for multi-parameter tests and for tests about the random part of the model. The general principle is as follows.

When parameters of a statistical model are estimated by the maximum likelihood (ML) method, the estimation also provides the likelihood, which can be transformed into the deviance defined as minus twice the natural logarithm of the likelihood. This deviance can be regarded as a measure of lack of fit between model and data, but (in most statistical models) one cannot interpret the values of the deviance directly, but only differences in deviance values for several models fitted to the same data set.

Suppose that two models are fitted to one data set, model M_0 with m_0 parameters and a large model M_1 with m_1 parameters. So M_1 can be regarded as an extension of M_0, with m_1-m_0 parameters added. Suppose that M_0 is tested as the null hypothesis and M_1 is the alternative hypothesis. Indicating the deviances by D_0 and D_1, respectively, their difference D_0-D_1 can be used as a test statistic having a Chi-Square distribution with m_1-m_0 degrees of freedom.

CHAPTER FOUR
RESULT AND DISCUSSION

4.1 Descriptive Results

In this study, we have examined dropout in contraceptive use as it varies with demographic, socio-economic and proximate characteristics. Table-2 and 3 present descriptive statistics of dropout from contraceptive use by region and place of residence, respectively, of 1343 currently married women included in the study. Among these, 515 (38.3%) were found to be currently using contraceptives whereas 828 (61.7%) were currently dropout in contraceptive use.

Table -2 Dropouts from contraceptive use by Region

Variables		Pattern of use		Total (Row %)
		Currently using	Dropout from contraceptive use	
Region(REGION)		515	828	1343
		38.3%	61.7%	100%
	Tigray	33	84	117
		28.2%	71.8%	100%
	Afar	6	20	26
		23.1%	76.9%	100%
	Amhara	43	150	193
		22.3%	77.7%	100%
	Oromiya	75	110	185
		40.5%	59.5%	100%
	Somali	6	3	9
		66.7%	33.3%	100%
	Ben-Gumz	22	64	86
		25.6%	74.4%	100%
	SNNP	46	81	127
		36.2%	63.8%	100%
	Gambela	29	48	77
		37.7%	62.3%	100%
	Harari	59	59	118
		50%	50%	100%
	Dire Dawa	29	49	78
		37.2%	62.8%	100%
	Addis Abeba	167	160	327
		51.1%	48.9%	100%

Table -3 Dropouts from contraceptive use by place of residence

Variables		Pattern of use		Total (Row %)
		Currently using	Dropout from contraceptive use	
Type of place of residence(PLACE)		515	828	1343
		38.3%	61.7%	100%
	Urban	355	381	736
		48.2%	51.8%	100%
	Rural	160	447	607
		26.4%	73.6%	100%

As can be seen from Table 2, the contraceptive status among currently married women varies from one region to the other. For example, the highest prevalence dropout in contraceptive use was observed in Amhara (77.7%) followed by Afar (76.9%). On the other hand, the lowest prevalence was recorded in Somali (33.3%) followed by Addis Ababa (48.9%). The educational status of married women under consideration is an important variable with regard to dropout in contraceptive use. Among the respondent women those who have secondary or higher educational level were less likely to dropout in contraceptive use (51.6%) than primary (60.9%) and no education (71.1%). This indicates that completing at least primary level of school would help to decrease the prevalence of dropout in contraceptives use (see appendix A).

Table 3 depicts that the proportion of dropout differs by type of place of residence. The contraceptive usage status of women who reside in urban areas is that 38.3% are current users of contraceptives and the remaining 61.7% are dropouts. Among rural women, 26.4% were current users and 73.6% were dropouts. The prevalence rate of dropout in contraceptive use was higher among women who reside in rural areas (73.6%) as compared to urban areas (51.8%).

The number of living children of married women is an important variable with regard to dropout from contraceptive. Married women who have no living children (25.5%) were currently users, and 74.5% were currently dropout in contraceptive use. Among women with 1-2 living children 44.7% were current users and 56.8% were dropout in contraceptive use. Among those women with three and more living children constituted 25.6% were current users and 74.4% were dropout in contraceptive use. Low

contraceptive prevalence rate of dropout was observed among the respondents who have one or two children. 3^{+} has similar to three children and no child (see appendix A).

It is believed that women's exposure to family planning message on radio may enhance use of contraception. From Appendix A, about 69.4% women who did not hear family planning messages on the radio in the last 12 months before the survey were dropouts from contraceptive use, while 55.2% of married women who heard family planning messages on the radio were currently dropout of contraceptive use. But it is the reverse for current users of contraceptive: 30.6% have not heard and 44.8% heard family planning message on radio. The prevalence rate of dropout in contraceptive use was higher among women who have not heard family planning message on radio in the last 12 months before survey. Access to health facility is an important motivation to change the perception of women on contraceptive behavior. About 66.8% of married women who did not visit health facilities in the last 12 months before the survey were dropouts from contraceptive use; while only 56.6% of women who visited health facilities were dropouts (see Appendix A).

Finally, the proximate variable that is reason of discontinuation was found to be an important variable as a determinant with regard to dropout in contraceptive use. The highest proportion of dropout in contraceptive use was due to reasons grouped under "other" (70.2%). (These include husband's disapproval, difficulty to get modern contraceptive methods, misinformation about religious aspects of family planning, etc.) The second highest reason for discontinuation was the need for more children (65.2%) followed by fear of possible sideeffects (60%); while those women who want more effective method (0%) does not affect dropout from contraceptive use (see Appendix A).

Table-4 Pearson Chi-Square and Likelihood Ratio Result

Variables	P-value		df
	Pearson Chi-Square	Likelihood Ratio	
Reason of last discontinuation(RLD)	.000	.000*	4
Region(REGION)	.000	.000*	10
Type of place of residence(PLACE)	.000	000*	1
Current age of respondent(AGE)	.124	.117	2
Heard FP on radio last12 months(HFP)	.000	.000*	1
Visited by FP worker last 12m(VFP)	.750	.8171	1
Visited health facil. last 12m(VHF)	.000	.000*	1
Religion(RELIGION)	.612	.610	3
Women education(EDC)	.000	.000*	2
Number of living children(NLC)	.000	.000*	2

* Statistically significant at 0.05 level of significance

As can be seen from Table 4, with the 0.05 level of significance, the Pearson Chi-Square and Likelihood Ratio shows that there is a significant difference in reason of last discontinuation from contraceptive use (RLD), type of place residence (PLACE), heard of FP on radio last 12 months (HFP), visited health facility last 12 months (VHF), women education (EDU) and number of living children (NLC) between dropout from contraceptive use and contraceptive use groups of women. On the other hand, there was no significant difference in current age of respondent (AGE), advice by FP worker last 12 month (VFP) and Religion (RELIGION) between dropout from contraceptive use and contraceptive use groups of women.

.4.2 Logistic regression Result

4.2.1 Variable selection

4.2.1.1 Univariate result

A univaraite logistic regression of each predictor variable against contraceptive status was performed to select the significant candidate predictor variables that would qualify for the multiple logistic regression model. The results are presented in Table 5.

Table-5 Logistic regression result of each predictor variable with the response variable

Variables	B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
REASON (RLD)			15.585	4	.004*			
Wanted more children(1)	-.225	.142	2.525	1	.112	.798	.605	1.054
Health concerns(2)	-.590	.152	15.090	1	.000	.554	.411	.746
Wanted more eff.meth(3)	-22.06	5146.2	.000	1	.997	.000	.000	
Side effects(4)	-.449	.339	1.758	1	.185	.638	.328	1.240
Others(rc)	-	-	-		-	1	-	-
REGION			64.964	10	.000*			
Tigray(1)	.977	.233	17.536	1	.000	2.657	1.682	4.197
Afar(2)	1.247	.478	6.791	1	.009	3.479	1.362	8.886
Amhara(3)	1.292	.205	39.609	1	.000	3.641	2.435	5.445
Oromiya (4)	.426	.186	5.231	1	.022	1.531	1.063	2.205
Somali (5)	-.650	.716	.826	1	.364	.522	.128	2.122
Ben-Gumz (6)	1.111	.271	16.825	1	.000	3.036	1.786	5.162
SNNP (7)	.609	.215	7.997	1	.005	1.838	1.205	2.802
Gambela (8)	.547	.260	4.425	1	.035	1.728	1.038	2.875
Harari (9)	.043	.215	.040	1	.842	1.044	.685	1.590
Dire Dawa(10)	.567	.259	4.795	1	.029	1.764	1.061	2.930
Addis Abeba(rc)	-	-	-	-	-	1	-	-
PLACE(Urban)	-.957	.118	65.712	1	.000*	.384	.305	.484
Rural(rc)	-	-	-	-	-	1	-	-
AGE			4.135	2	.127			
15-19(1)	.331	.267	1.530	1	.216	1.392	.824	2.351
2o-34(2)	-.139	.131	1.124	1	.289	.870	.673	1.125
35-49(rc)	-	-	-	-	-	1	-	-
HFP(Yes)	-.610	.115	28.146	1	.000*	.543	.434	.681
No(rc)						1		
VHF(Yes)	-.432	.113	14.632	1	.000*	.649	.520	.810
No(rc)	-	-	-	-	-	1	-	-
RELIGION			1.813	3	.612			
Other (1)	-.015	.462	.001	1	.974	.985	.399	2.436
Protestant(2)	.187	.174	1.160	1	.282	1.206	.858	1.696
Moslem(3)	.138	.138	.997	1	.318	1.148	.876	1.505
Orthodox(rc)	-	-	-	-	-	1	-	-
EDU			40.607	2	.000*			
Secondary and above(1)	-.839	.132	40.646	1	.000	.432	.334	.559
Primer education(2)	-.456	.14	9.395	1	.002	.634	.473	.848
No education(rc)	-	-	-	-	-	1	-	-
VFP(Yes)	.056	.176	.102	1	.750	1.058	.749	1.494
No(rc)	-	-	-	-	-	1	-	-
NLC			44.909	2	.000*			
3^{+}(1)	.007	.312	.000	1	.983	1.007	.546	1.857
1-2(2)	-.857	.135	40.011	1	.000	.425	.326	.554
0(rc)	-	-	-	-	-	1	-	-

- Rc-reference category

-* Statistically significant at $p < 0.05$

Result of Table 5 indicate that each of RLD, REGION, PLACE, HFP, VHF, EDUCATION, and NLC were significantly related with the currently dropout from contraceptive use. This means separate effect of each of this predictor on dropout in contraceptive use status was significant. But AGE, VFP and RELIGION were not significant. Hence, taking into account the socio demographic importance to the study and assessing its univariate test result (p-value=0.127 is less than 0.25), the predictor AGE was the only variable among the non significant variables that was included in multiple logistic regression model together with significant predictors.

Hence, based on univariate tests presented in Table 5, eight predictor variables were candidate for multiple logistic regression model. The selected variables were RLD, REGION, PLACE, HFP, VHF, EDU, NLC and AGE.

4.2.1.2 Result of the multiple logistic regression

One problem with any univariate approach is that it ignores the possibility that a collection of variables, each of which is weakly associated with the outcome, can become an important predictor of the outcome when taken together. If this is thought to be a possibility, then we should choose a significance level large enough to allow the suspected variables to become candidates for inclusion in the multivariate model. It is for this reason that we used p-value of 0.25 for selection of variables that are candidates for the multivariate analysis from univariate findings. Multivariate analysis is done using the significant variables in the univariate analysis. Forward stepwise likelihood ratio method is used to select the variables.

Table 6 shows that the out of eight predictors which were selected in univariate analysis, six predictors and one interaction were selected in the final model in multivariate analysis.

Table-6 Multiple logistic regression result of predictors and interaction in the final model.

Variables	B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
REASON			18.776	4	.001*			
Wanted more children(1)	-.100	.159	.395	1	.529	.905	.663	1.236
Health concerns(2)	-.683	.169	16.412	1	.000	.505	.363	.703
Wanted more eff.meth(3)	-22.29	4786.3	.000	1	.996	.000	.000	
Side effects(4)	-.222	.368	.364	1	.546	.801	.389	1.647
Others(rc)	-	-	-	-	-	1	-	-
REGION			24.536	10	.006*			
Tigray(1)	.692	.281	6.042	1	.014	1.997	1.150	3.467
Afar(2)	1.231	.551	4.988	1	.026	3.424	1.163	10.08
Amhara(3)	.808	.256	9.951	1	.002	2.244	1.358	3.709
Oromiya (4)	-.029	.232	.016	1	.901	.972	.617	1.530
Somali (5)	-.524	.780	.451	1	.502	.592	.128	2.733
Ben-Gumz (6)	.765	.328	5.459	1	.019	2.150	1.131	4.086
SNNP (7)	.228	.262	.754	1	.385	1.255	.751	2.098
Gambela (8)	.215	.310	.480	1	.489	1.240	.675	2.277
Harari (9)	.208	.252	.680	1	.410	1.231	.751	2.017
Dire Dawa(10)	.354	.284	1.560	1	.212	1.425	.817	2.486
Addis Abeba(rc)	-	-	-	-	-	1	-	-
PLAC(Urban)	-1.295	.231	31.377	1	.000*	.274	.174	.431
Rural(rc)	-	-	-	-	-	1	-	-
HFP(Yes)	-.709	.209	11.498	1	.001*	.492	.327	.742
No(rc)	-	-	-	-	-	1	-	-
VHF(Yes)	-.297	.131	5.160	1	.023*	.743	.575	.960
No(rc)	-	-	-	-	-	1	-	-
NLC			85.410	2	.000*			
3^{+}(1)	-.453	.362	1.569	1	.210	.636	.313	1.291
1-2(2)	-1.485	.165	80.678	1	.000*	.227	.164	.313
0(rc)	-	-	-	-	-	1	-	-
HFP(Yes) *PLACE(Ur)	-.611	.277	4.852	1	.028*	.543	1.070	3.171
HFP(No) *PLACE(Ru)	-	-	-	-	-	1	-	-
Constant	2.645	.273	93.678	1	.000	14.088		

-* Statistically significant at $p < 0.05$

-rc-reference category

4.2.2 Interpretation of the final model of logistic regression

Since all variables that enter the model were categorical, their odds must be interpreted relative to the reference category rather than as a simple increase or decrease in odds. The negative odds-ratio of the categorical variables implies that the likelihood of dropout from contraceptive use is lower than the reference category.

Among different reasons for dropout from contraceptive use, health concern was found lowest as compared with reasons grouped under "others"(husband's disapproval, difficulty to get modern contraceptive methods, misinformation about religious aspects of family planning, etc)(odds ratio= 0.505).

The region in which women reside is an important determinant of dropout from contraceptive. When we study each region closely, we find that more women living in Afar dropout from contraceptive use than women in Addis Ababa (odds ratio =3.424) followed by Amhara (odds ratio = 2.244) and Benshangul-Gummuz (odds ratio =2.150) respectively.

Visiting a health facility is an important variable affecting dropout in contraceptive use. Women who visited health facilitates have a better chance to know about contraceptives. Indeed, the odds of dropout in contraceptive use of a woman who visited a health facility in the last 12 months before the survey was found to be less likely (odd ratio=0.743) to dropout from contraceptive use than a woman who did not visit a health facility.

Number of living children is also found to be an important predictor. The results indicate that women with one or two children are less likely to dropout from contraceptive use as compared to those who have no children(odds ratio =0.227)

In the case of interaction, the odd of women who live in urban areas and who had exposure to family planning message are less likely to dropout from contraceptive use than women who live in rural areas and had not heard any family planning message for the last 12 months before the survey (odd ratio =0.543).

4.2.3 Goodness of fit and Model Diagnostics

a. Goodness of fit

In our logistic regression analysis of the data by SPSS package, results of several goodness of fit test accompany the SPSS output. Hence, from these outputs we will use some of them here in order to check goodness of fit of our model.

i. The classification table

The classification table shows that of 1343 married women included in the analysis, 71.9% were correctly classified. This shows that the final logistic model performs well.

Table-7 Classification Table

Observed		Predicted		
		Pattern of use		Percentage Correct
		Currently using	Currently dropout	Currently using
Pattern of use	Currently using	274	241	53.2
	Currently dropout	136	692	83.6
Overall Percentage				71.9

The cut value is .500

ii. -2LL statistic for the logistic model that contains only the constant and the final logistic regression model

A good model is one that results in the high likelihood of the observed results. This translates to small values of -2LL. If a model fits perfectly, the likelihood is 1 (meaning -2LL is 0). The difference between -2LLof the final model ($-2LL_f$ =1444.327) and-2LL of the model with only the constant ($-2LL_c$ =1788.170) is 343.843. The likelihood ratio test ($\lambda^2_{caiculated} > \lambda^2_p(\alpha)$) indicated that the final model fits the data.

iii. Hosmer-Lemeshow test

The Hosmer-Lemeshow test is the recommended test for overall fit of the logistic regression.

The hypothesis to be tested here is:

H_o: the model fit the data Vs H_1: not Ho

Table-8 Hosmer and Lemeshow Test

Chi-square	df	Sig.
8.364	8	.399

Statistically significant at $p < 0.05$

Table 8 presents Hosmer-Lemeshow's goodness of fit test result for the fitted logistic regression model. As can be seen from the table, the model gave a Chi-square value of 8.364 with 8 degrees of freedom having a p-value 0.399 which is greater than 0.05. Therefore, we do not reject the null hypothesis and conclude that there is no difference between the observed and the model predicted values of the dependent variable and thus, we can conclude that the fitted model is adequate.

iv. The Omnibus/Likelihood ratio test of model coefficient

The Omnibus test is a test of the capability of predictors in the model to jointly predict the response variable. The finding as illustrated in Table 9 below indicates that there is adequate fit of the data to the model; meaning that at least one of the predictors is significantly related to the response variable.

Table-9 Omnibus Tests of Model Coefficients

	Chi-square	df	Sig.
Step	343.843	20	.000
Block	343.843	20	.000
Model	343.843	20	.000

b. Model diagnosis

The adequacy of the fitted model was checked for possible presence and treatment of outliers, influential values and multicollinearity. The diagnostic test results for detection of outliers and influential values are presented in Appendix C

The results show that the normalized residuals are within the interval of -3 and 3 implying that no outliers were detected at 0.05 level of significance. 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. The leverage statistic less than one shows that no subject has a substantial large impact on the predicted values of model.

Thus, from the above goodness of fit tests and diagnostic checking, we can say that our model is adequate.

4.3 Multilevel Logistic Regression Result

4.3.1 Test of Heterogeneity

In the multilevel analysis a two-level structure is used with regions as the second-level unit and married women who dropout from contraceptive use as the first-level units. This is done basically with the expectation that there would be a difference in contraceptive status of married women among the regions. The preliminary analysis using logistic regression in the previous section also revealed such differences. A chi-square test statistic given in equation (15) was applied to assess heterogeneity in the proportion of married women dropout in contraceptive among the 11 regions. The test yields X^2=42.199, $d.f.=10$, $P<0.05$. Thus, there is evidence for heterogeneity among the regions with respect to married women who dropout from contraceptive use. The analysis is carried out using student-version software LISREL for window.

4.3.2 Two level empty logistic Regression

The empty model contains no explanatory variables and it can be considered as a parametric version of assessing heterogeneity among regions with respect to contraceptive status of married women. Fitting the empty model discussed in section 3.3.2.2.3 to the data on contraceptive usage status of married women yields the parameter estimates presented in Table 10.

Table-10 Estimates for empty model

Fixed Part	Coefficient	S.E.	Z-value	P-value
Φ_{00}= Intercept	-0.5568	0.0572	-9.7413	0.0000*
Random Part	**Variance Component**	**S.E.**	**Z-value**	**P-value**
Level-two variance: $\omega_{00} = \text{var}(U_{0j})$	0.1631	0.0578	2.8209	0.0048*
Deviance-based chi-square	65.3774			0.000*

* Significant ($p<0.05$)

The deviance based Chi-square (deviance = 65.3774) indicated in Table 10 above is the difference in deviance between an empty model without random effect (deviance = 1788.1703, see Appendix D) and an empty model with random effect (deviance 1722.7928 see Appendix D). This implies that an empty model with random intercept is better than an empty model without random intercept.

The intra class-correlation (discussed in section 3.3.2.2.3 of equation (21)) is:

$$\text{ICC} = \frac{\omega_{00}}{\omega_{00} + \sigma^2_e} = \frac{0.1631}{0.1631 + 0.2365} = 0.408$$

where σ^2_e is calculated based on equation (21).

Next, we present the results obtained by using random intercepts and fixed slopes (coefficients) multilevel logistic regression analysis for selected explanatory variables. Since we used the student version of the software LISREL, the predictor variables were restricted to only two categories each.

4.3.3 Two level random intercept and fixed slope (coefficient)

In order to identify the effect of some selected explanatory variables, a multilevel logistic regression model with random intercept and fixed explanatory variables were estimated with the help of LISREL software. The variables considered were Reason of discontinuation in the last 12 months (0= want more children, 1= others), Type of place of residence (0= urban, 1= rural), Heard family planning on radio last 12 months (0= yes, 1= no), Visited health facility last 12 months (0= yes, 1= no), and Number of living

children (0=no child, 1= more than one children). The results of two-level random intercept and fixed slope (coefficient) model are presented in Table 11 below.

Table -11 Estimates for random intercept and fixed coefficient model

Covariates	Estimate coefficient	S.E.	Z-value	P-value
Intercept	0.5760	0.217	2.6486	0.0081*
Type of place of Residence				
Rural (Ref.)				
Urban	-0.734	0.126	-5.8040	0.0000*
Heard FP on radio last months				
Yes	-0.297	0.124	-2.3843	0.0171*
No (Ref.)				
Visited health facil. last 12m				
Yes	-0.299	0.117	-2.5543	0.0106*
No (Ref.)				
Number of living children				
0	0.120	0.130	0.926	0.35400
>=1 (Ref.)				
Reason of last discontinuation				
Wanted more Child	0. 3255	0.123	2.646	0.0472*
Others (Ref.)				
Random Part	**Estimate Variance component**	**S.E.**	**Z-value**	**P-value**
Random Intercept: $\omega_{oo} = \text{var}(U_{0j})$ intercept variance	0.0408	0.018	2.2364	0.0253*
Deviance-based chi-square	15.8266			0.0001*

* Significant (P<0.05)

As can be seen from the table above, the variance component representing variation between regions has diminished markedly from 0.1631 in the empty model to 0.0408 in the random intercept and fixed slopes multilevel logistic regression model. This tells us that the listed predictors explain a large portion of the region-to-region variation in mean dropout in contraceptive use and the significance of the predictors also indicate regional differences in the status of contraceptive. The deviance based on Chi square (deviance = 15.8266) is the difference in deviance between a random intercept with fixed effect variables (deviance =1684.7433 see Appendix E) and a model without a random intercept with the fixed effect variables (deviance = 1700.5699, see Appendix E).

As can be seen from the difference, the deviance Chi-square was significant at 0.05 level of significance. This implies that a model with random intercept and fixed slopes is

appropriate to see the region-to-region variation in mean dropout in contraceptive use than a model without a random intercept with the same fixed slopes. In addition, except number of living children, all predictors are found to be significant determinants of variation in contraceptive dropout among the regions.

4.3.4 Two level random intercept and random slope (coefficient)

The random coefficient model is useful, because it shows how much variability exists at each level. Result of Table 12 below is obtained by including level-2 random coefficients of RLD, PLACE, HFP, VHF and NLC and an overall (level-2) or regional variance constant term (ω_{oo}) together with variance and covariance terms representing the random effects of predictors.

Table -12 Estimate of random intercept and random slope (coefficient)

Fixed Part	**Estimate coefficient**	**S.E.**	**Z-value**	**P-value**
Intercept	0.5339	0.2181	2.4480	0.0144*
Type of place of Residence(PLACE)				
Urban	-0.7022	0.1270	-5.5287	0.0000*
Rural (Ref.)				
Heard FP on radio last months(HFP)				
Yes	-0.3588	0.1253	-2.8623	0.0042*
No (Ref.)				
Visited health facil. last 12m(VHF)				
Yes	-0.2720	0.1183	-2.2991	0.0215*
No (Ref.)				
Number of living children(NLC)				
0	0.1411	0.1314	1.0739	0.2829
>=1 (Ref.)				
Reason of last discontinuation(RLD)				
Wanted more Child	0.2521	0.1248	2.0198	0.0434*
Others (Ref.)				
Random Part	**Estimate Variance component**	**S.E.**	**Z-value**	**P-value**
Random Coefficient:				
Level-2 variance and covariance				
$\omega_{00} = \text{var}(U_{0j})$	0.2148	0.0784	2.7397	0.0112*
$\omega_{11} = \text{var}(U_{1j})$	0.0589	0.0363	1.6203	0.1052
$\omega_{22} = \text{var}(U_{2j})$	0.1043	0.0479	2.1762	0.0295*
$\omega_{33} = \text{var}(U_{3j})$	0.2262	0.0900	2.5143	0.0119*

$\omega_{44} = \text{var}(U_{4j})$	0.0244	0.0162	1.5058	0.1321
$\omega_{55} = \text{var}(U_{5j})$	0.0740	0.0340	2.1783	0.0294*
$\omega_{01} = \text{cov}(U_{0j}, U_{1j})$	-0.0283	0.0428	-0.6615	0.5083
$\omega_{02} = \text{cov}(U_{0j}, U_{2j})$	0.0750	0.0498	1.5076	0.1317
$\omega_{03} = \text{cov}(U_{0j}, U_{3j})$	-0.1057	0.0614	-1.7219	0.0851
$\omega_{04} = \text{cov}(U_{0j}, U_{4j})$	-0.0480	0.0293	-1.6366	0.1017
$\omega_{05} = \text{cov}(U_{0j}, U_{5j})$	-0.0670	0.0411	-1.6298	0.1031
$\omega_{12} = \text{cov}(U_{1j}, U_{2j})$	0.0121	0.0297	0.4084	0.6830
$\omega_{13} = \text{cov}(U_{1j}, U_{3j})$	-0.0565	0.0416	-1.3598	0.1739
$\omega_{14} = \text{cov}(U_{1j}, U_{4j})$	-0.0027	0.0161	-0.1657	0.8684
$\omega_{15} = \text{cov}(U_{1j}, U_{5j})$	-0.0248	0.0242	-1.0249	0.3054
$\omega_{23} = \text{cov}(U_{2j}, U_{3j})$	-0.0966	0.0529	-1.8257	0.0679
$\omega_{24} = \text{cov}(U_{2j}, U_{4j})$	-0.0373	0.0212	-1.7545	0.0793
$\omega_{25} = \text{cov}(U_{2j}, U_{5j})$	-0.0493	0.0308	-1.6036	0.1088
$\omega_{34} = \text{cov}(U_{3j}, U_{4j})$	0.0604	0.0285	2.1189	0.0341*
$\omega_{35} = \text{cov}(U_{3j}, U_{5j})$	0.1247	0.0511	2.4416	0.0146*
$\omega_{45} = \text{cov}(U_{4j}, U_{5j})$	0.0352	0.0187	1.8869	0.0592*
Deviance-based chi-square	50.6896			0.0003*

* Significant (P<0.05)
Ref. =Reference category

Table 13 Level-2 Covariance Matrix of the Random Coefficient

	Intercept	PLACE	HFP	VHF	REASON	NLC
Intercept	0.124807					
PLACE	-0.028329	0.058894				
HFP	0.075039	0.012116	0.104339			
VHF	-0.105734	-0.056512	-0.096606	0.226181		
REASON	-0.048006	-0.002671	-0.037277	0.060382	0.024421	
NLC	-0.067022	-0.024827	-0.049337	0.124679	0.035219	0.073969

Table 14 Level-2 Correlation Matrix of the Random Coefficient

	Intercept	PLACE	HFP	VHF	REASON	NLC
Intercept	1.000000					
PLACE	-0.330427	1.000000				
HFP	0.657575	0.154562	1.000000			
VHF	-0.629316	-0.489641	-0.628859	1.000000		
REASON	-0.869552	-0.070434	-0.738472	0.812459	1.000000	
NLC	-0.697544	-0.376151	-0.561593	0.963919	0.828649	1.000000

In Table 12 above, the value of Var (U0j), Var (U_{1j}), Var (U_{2j}), Var (U_{3j}), Var (U_{4j}) and Var (U_{5j}) are the estimated variance of intercept, slope of RLD, slope of PLACE, slope of HFP, slope of VHF and slop of NLC respectively. Except NLC the corresponding p-values are small, suggesting that regionwise intercepts and slopes vary significantly, that is, there is a significant variation in the effects of these explanatory variables across the regions. Some of the variance of the interaction terms between intercepts and slopes of explanatory variables are also found significant. Interpretation of significant covariance terms can be easily made in terms of the correlation coefficients displayed in Tables 13 and 14. The correlation matrix contains the estimated correlation between random intercepts and slopes.

Positive correlation between intercepts and slopes implies that regions with higher intercepts tend to have on average higher slopes (Table 14). For example, the correlation between the intercept and random slope of HFP is 0.657575, means that married women who heard family planning message on radio tend to use contraceptive better than those who have not heard family planning message on radio by a larger factor at 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 (Table-14). Married women whose place of residence is in urban, who have access to family planning lessons through mass media and who have visited health facilities are less likely to dropout from contraceptive use. Similarly, married women who have no children and their reasons were want more children are more likely to dropout from contraceptive use.

The multilevel multivariate analysis result in Table 12 shows that the listed predicted variables except NLC significantly contribute to the use of contraceptives. The deviance-based Chi-square (deviance = 50.6896) indicated in Table 12 is the difference between model without any random effects (deviance = 1700.5699 see Appendix F) and model with fixed and random effects (deviance =1649.8803 see Appendix F). This difference

indicates that a model with a random coefficient is better to explain the regional variation than a model with fixed coefficients

We note that the student version of the software LISREL does not provide model diagnostic tests. We only checked a goodness of fit by using deviance-based chi-squared test.

In general, the results of the multilevel logistic regression suggest that there exist difference in contraceptive dropout of married women among the regions in Ethiopia. As a result, the random coefficient model analysis generates separate estimates of logistic regressions for each region (Table 15).

Table-15 Parameter estimates for regions

Region		coefficients					
		intcept	PLACE	HFP	VHF	REASON	NLC
Tigray	Estimate	-0.348	-0.151	-0.4496	0.61823	0.19107	0.32794
	S.E	0.06951	0.03959	0.05195	0.0872	0.0119	0.02941
	Z.value	-5.006*	-3.813*	-8.655*	7.0901*	16.059*	11.152*
Afar	Estimate	0.17916	0.05712	0.04681	-0.3573	-0.0934	-0.2226
	S.E	0.10556	0.05526	0.0875	0.17037	0.01988	0.055
	Z.value	1.6973	1.0336	0.5349	-2.097*	-4.699*	-4.048*
Amhara	Estimate	0.14733	-0.1547	-0.2087	-0.0456	-0.0184	-0.0802
	S.E	0.06407	0.03089	0.03934	0.06026	0.01032	0.02214
	Z.value	2.2995*	-5.007*	-5.305*	-0.756	-1.784	-3.623*
Oromiya	Estimate	-0.1314	0.24688	0.09919	-0.1998	0.00097	-0.0699
	S.E	0.05399	0.02902	0.03798	0.05315	0.00901	0.01903
	Z.value	-2.433*	8.508*	2.6114*	-3.759*	0.1078	-3.672*
Somali	Estimate	0.01798	-0.0283	0.05333	0.05213	-0.0019	0.03218
	S.E	0.11267	0.05601	0.09107	0.17698	0.02077	0.05854
	Z.value	0.1596	-0.505	0.5856	0.2946	-0.094	0.5497
Ben-Gumz	Estimate	-0.0368	-0.082	-0.161	0.13713	0.03509	0.05642
	S.E	0.08404	0.03948	0.05158	0.09888	0.01384	0.03543
	Z.value	-0.438	-2.078*	-3.121*	1.3869	2.5344*	1.5923
SNNP	Estimate	-0.0211	-0.127	0.0272	0.27548	0.03681	0.16025
	S.E	0.07737	0.03483	0.04548	0.07661	0.01254	0.02717
	Z.value	-0.272	-3.646*	0.5982	3.5957*	2.9345*	5.8992*
Gambela	Estimate	-0.364	0.10043	-0.1681	0.31391	0.14046	0.20332
	S.E	0.08326	0.04458	0.05541	0.10842	0.01443	0.03596
	Z.value	-4.372*	2.2528*	-3.034*	2.8953*	9.7367*	5.6534*
Harari	Estimate	-0.0137	-0.0818	0.09247	0.21635	0.02113	0.13175
	S.E	0.06999	0.04059	0.05924	0.06021	0.01069	0.02112
	Z.value	-0.195	-2.015*	1.5611	3.5931*	1.977*	6.2375*
Dire Dawa	Estimate	0.37592	0.19105	0.29639	-0.8004	-0.2181	-0.4505
	S.E	0.08707	0.09878	0.05403	0.08426	0.0131	0.02982
	Z.value	4.3173*	1.9341	5.4859*	-9.499*	-16.65*	-15.11*
A ddis Abeba	Estimate	0.19454	0.02925	0.37208	-0.2102	-0.0936	-0.0887
	S.E	0.05922	0.04139	0.02377	0.03223	0.00747	0.0122
	Z.value	3.2849*	0.7068	15.654*	-6.521*	-12.52*	-7.269*

* Significant ($p<0.05$)

Table 15 shows that, for example, all variables are significant in Tigray and Gambela region. Except place of residence all variables are significant in Addis Ababa and Dire-Dawa (because for Addis Ababa and Dire-Dawa place of residence cannot be categorized as urban and rural). But in Somali region, all variables are not significant and similar results are observed in logistic regression as well as in descriptive analysis.

Generally, Table 15 shows the presence of variation among regions with respect to the impact of the predictor variables on the contraceptive dropout status of women.

CHAPTER FIVE
SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Summary

The main objective of the study was to identify some of the factors that influence women to dropout from contraceptive use. Descriptive analysis was used to compare the percentage of contraceptive dropout pattern among the selected factors. Dropout in contraceptive use was then examined using logistic regression model. Finally, based on multilevel logistic regression model, the existence of significant variation in the predictors among the regions was discovered.

At first, the study included ten predictor variables that were categorized under Demographic, Socio-economic, and proximate characteristics. The descriptive analysis of the study revealed that only 38.3% of the sample women were currently using contraceptive and 61.7% dropout from contraceptive use.

The result of univariate analysis indicated that all variables considered except religion, access to family planning lessons through mass media (VFP) and age had the expected signs and were significant to be considered as candidates for the multiple logistic regression model. By employing the forward step wise (likelihood ratio) method, six predictors and one possible interaction were selected as major determinants of dropout from contraceptive use. The goodness of fit and significance tests of each predictors of the multiple logistic regression model provided statistically significant results. This implies that the predictor variables have significant joint and separate influence in explaining the variation in the outcome variable. Model adequacy diagnostic tests of the multiple logistic regression model show that there were no outliers and no influential values that had significant impact on the regression results. Besides, the collinearity diagnostic tests show that multicollinearity was not a great threat to the reliability of model coefficients. Applying a multilevel logistic regression, the impact of selected variables was shown to vary from region to region.

5.2 Conclusion

All the significant factors associated with contraceptive dropout have direct relationship. It is known that contraceptive dropout is an important issue in family planning service program. From the descriptive results, the main reason for dropout was multiple responses that were grouped under "Others" (70.2%) followed by the need for more children (65.2%).The "Other" category includes such as husband's disapproval, difficulty to modern contraceptive methods, misinformation about religious aspects of family planning, etc. The socio-economic determinant of residence area gives expected results (73.6% of rural and 51.8% of urban women are dropouts). Similarly, the logistic regression results show that the discontinuation of women in urban area was found to be lower than those in rural area.

Reaching people with information about family planning through the mass media can create awareness about family planning and promote information about contraceptive use. Our results confirmed that women who had access to family planning lessons through mass media are less likely to dropout from contraceptive use as compared to those who did not have access. Our results also indicated that women who visited a health facility have a better chance of satisfying their demand for contraceptives, and hence less likely to dropout from contraceptive use. Hence accessibility of health care facility is a management problem that needs to be addressed at a higher level.

The multilevel multivariate analysis has revealed that the main effects of the predictors such as reason of last discontinuation from contraceptive use, place of residence, accessibility of family planning lessons through mass media in the last 12 months, access to health facility in the last 12 months and number of living children on dropout in contraceptive use varied considerably among regions.

5.3 Recommendations

Based on the findings of the current study the following recommendations are forwarded:

- Establish health care facilities closer to the community.
- Train health care workers to improve their knowledge and skills to treat sideeffects of contraceptive.
- Enhance information and communication activities regarding family planning services using mass media and health centers.
- Special attention be given to rural areas where the program efforts remained less effective.
- In order to ensure wider expansion of contraceptive usages, government and non-government organization involved in FP should organize discussion groups of currently marred women on issues of FP.
- Development polices and strategies designers should consider the adoption of family planning service.
- All concerned bodies should conduct similar research to solve problems related to family planning in all parts of the country.

REFERENCES

Agresti, A. (1990). "Categorical Data Analysis". John Wiley and Sons, Inc., New York.

Agresti, A. (1996). "An Introduction to Categorical data Analysis." John Wiley and Sons, Inc., New York.

Alsawi, M. and Adamchak, D.J. (2000) Women's status, Fertility and Contraceptive use in Kazakhstan: GENVS, LVI (N, 1-2)

Antenane Korra, (2002), "Attitudes toward family planning and Reason for Non use among Women with Unmet need for Family Planning in Ethiopia."Calverton, Maryland USA: ORC Macro

Arnold, F. (1975). "The value of children across cultural study." Vol. I Hawaii East West population Institute, East-West Center

Bandarage, A (1997). "Women Population and Global Crisis": A Political Economic Analysis. Zed Book Ltd London.

Bongaarts, J. (1993). "Population growth and the food supply". The Population Council, New York.

Bongaarts J. (1994). "Family Planning and Development", Network Vol. 15 No 1

Bongaarts.;Mauldin W.P.; and Phillips J.F. (1990). "The Demographic impact of Family Planning programs" Studies in family planning,Vol,21, No.6, Population council, New York.

Boserup (1985). "Economic and Demographic Interrelations in sub-Saharan Africa", population and development Review , V.II No (3):383-399

Boukier B. (1985). "Family Planning programs and contraceptive availability: their facts on contraceptive use on fertility" ,edited by Nancy Birdsall, world Bank staff working paper No 677, Washington D.C., World Bank

Burstein, L., Kim, K-S., and Delandshere, G. (1989). "Multilevel investigation of systematically varying slops": Issues, alternatives, and consequences. In R.D.Bock (Ed), Multilevel analysis of educational data (pp. 223-276). San Diego, CA:

Academic Press

Central Statistical Agency (2006). "Ethiopia Demographic Health Survey" Addis Ababa, Ethiopia

Central Statistical Authority (CSA), 1999. "The 1994 Population and Housing Census of Ethiopia. Result at country level." Vol.II Analytical report

Central statistics Authority (2001). "Ethiopia Demographic and Health Survey", Addis Ababa, Ethiopia.

Charles Ketende, Neeru Gupta and Ruth Bessinger (2003). Facility based RH interventions and contraceptive use in Uganda. International Family planning perspectives. 29(3):130-137.

Collet, D. (1991). "Modeling Binary Data". Chapman & Hall, London

Commenges, D. and Jacqmin, H. (1994). "The intra-class correlation coefficient distribution frees definition and test". Biometrics, 50, 517-526.

Copas, J.B. (1988). "Binary Regression Models for Contaminated Data". Journal of Royal Statistical Association, B 50 (2): 225-265.

Curtis, initial and Neitzel, K. (1996). "Contraceptive Knowledge, Use and Sources". Calverton, Maryland: Macro International.

Daniel Shale Yesus (1995). "Determinants of contraceptive non-use and unmet need among married women in Ethiopia" Addis Ababa, Ethiopia

Dennis P.Hogna, Bettemariam Berhanu, and Assefa Hailemariam (1999). "Household Organization Women's autonomy and contraceptive behavior in southern Ethiopia". Studies in family planning; 30(4):302-314.

Ethiopia Trend Report (2007) "Analysis of the 2000 and 2005 Demographic and Health Survey"

Fengyu Z., Amy O.,Tsui C,M. and Suchindran (1999). "The determinants of contraceptive discontinuation in northern India". Multilevel analysis of calendar data

Greene, W. H. (1993). "Econometric Analysis". Macmillan. New York.

Haile S. "Population Development and environment in Ethiopia" ECSP Report – ISSUE10- 2004

Hailemariam A., Welsh M and Nichols D.(2000). "Reproductive Health and Family planning In Two Underserved community in Tigray Regional State", Ethiopia: Finding from a Baseline survey.

Hosmer, D. and S. Lemeshow (1989). "Applied Logistic Regression". John Wiley and Sons Inc., New York.

Jain, K.A (1996). "Potential constraints to And Prospects of Improving Quality of care in Family Planning programs in developing countries". In UN (eds). Family Planning Health and Family Well-being, New York.

Jejeebhoy S. (1991). "Measuring contraceptive use failure and constitution: an over view of new approaches", PP 21-51 in measuring the dynamics of contraceptive use. New York United Nations.

Joesoef MR (1988). "Husbands approval of contraceptive use in Metropolitan Indonesia: Program Implications". Studies in Family planning, Vol.18, No.5, New York, Population council.

Kaona A.Fredric, Melanie N. Katssivo, Henry Ondolo, et al. (1996) "Factors that determine utilization of modern Contraceptives in east, central and Southern Africa". Afr .J. of Health sci, 3(4):133-137.

Kishor S. and Neitzel, K. (1996). The Status of women: Indicators for 25 countries. Calverton, Maryland: Macro International Inc.

Kobayashi F. (1986). "Contraception, Summary of Eighteenth National Survey on Family Planning", Compiled by Mainichi, New papers, Population Research Council Tokyo.

Maddala, G.S. (1992). "Introduction to Econometrics". 2nd Edition. Prentice-Hall.

Mahdy, N. and El. Zeiny, NA. (1999). "Probability of contraceptive continuation and its determinants" .East-Mediterranean Health Jornal.Alexandria University, Egypt.

McCullagh, P. and Nelder, J.A. (1989). "Generalized Linear Models". (2nd end.). London: Chapman and Hall.

Mensch,intial (1994). "Family Planning Services on contraceptive use in Peru": Studies in family planning 27(2): 59-75.

Miller, P.C., Kiani, A. and Minhas, A.J.(1997). On the Dynamics of Contraceptive Use in Pakistan. Population Council.

Ministry of Health (MOH) 2002/2003. Health and health programming department.

Ministry of Health and Economic Development (MoFED) (2005). Ethiopia: building on progress.

Mueller J. E. (1978). "The Economic value of children in peasant Agriculture". In Ronal G. Ridker (ed) population 4 Development Review. PP.98-152.

Najama S. (2005). "Prevalence and factors associated with dropouts in contraceptive use". Studies in rural areas of Peshawar.

Nancy, W., Obaidurrab, J P.and Khan, ME (2000). "Men in Bangladesh India and Pakistan Reproductive health issues" Karshap publishers Dhska

National Population Policy of Ethiopia (2005). "Government of Ethiopia". Addis Ababa, Ethiopia.

Njogu. (1991). "Trends and Determinants of contraceptive use". Studies in Kenya, Demography, Vol.28:59-62

Richard. S. (1988). "Contraceptive use and Fertility in Paraguay". Studies in Family Planning Vol.19, No.5, New York, Population council.

Sathara Z.A. and Chidambara, U.C. (1984). "Determinants of contraceptive use", Comparative Studies: Cross National Summaries. No. 36, 7-15

Sayed H.A., El-Khorazaty, MNand Way, A.A. (1986). "Fertility and Family Planning in Egypt", 1984, Egypt, national population councel, Cairo.

Shahid Ullah and Nitai chakroborty(1993). "Factors affecting the use of contraception in Bangladish". Asia-pacific population Journal, 3(4): 19-30.

Shane, B (1997). "Family Planning Saves Lives", Population Reference Bureau. Washington D.C January 1997.

Shapiro, D., and Tambasha, B.O. (1994). The importance of women's employment and education on contraceptive use and abortion in Kenya, Zaire. Demography 26(2) :65-76.

Shuler Sidney Ruth and Goldstein C. Mewyn (1986). "Family planning in Nepal from the user's and non user's perspectives". Studies in family planning, Vol. 17 No.2 New York, Population Council

Sinding S.W. (1994). "Seeking Common Ground: Unmeet need and Demographic Goals" International Family planning Perspectives.

Sita S. (2003). "Assessment of the magnitude, determinant of unmet need for family planning". Ethiopia Addis Ababa 2003 (Thesis AAU DHS)

Snijders Tom A.B. and Roel J. Bosker (1999). "An introduction to basic and

advanced multilevel modeling". Department of Statistics, University of Poone, Pune 7.

SPSS (2006). "Statistical Support Algorithms". (Htt://Faculty.Chass.ncsu.edu/garson/PA765/logistic.htm.).pdf

Swar-Eldahab A, M. (1993). "Constraints on Effective Family Planning in Urban Sudan" Studies in family planning.Vol.24, No.6:370, New York, Population Council.

UN (1991) "Fertility Behavior in the context of development" United Nations (1994) Report of the International Conference on Population and Development, Cairo, Egypt. New York: United Nation

UNFPA (1999). Advocating Change: "Population Empowerment Development". United Nation Family Planning Activities (UNFPA) 1999 Bulletin E/6000/1997 R/6000/1999

Westoff, C.F (1992). "The demand for family planning estimated for developing countries". Family planning programs and fertility .Edited by James F. Phillips and John A. Ross, Oxford.

Westoff C.F., Moreno L., and Goldman (1989). "The Demographic impact of Changes in contraceptive Practice in Third World Populations". Population and Development Review, Vol.15, No.1.

World Bank (1995). "Family planning Services and education make a difference": contraception and fertility in Zimbabwe. International Family planning perspectives

Yigezaw Kebede (2000). "Contraceptive prevalence and factors associated with usage of Contraceptive around Gondar town". Ethiop .J. of Health Dev. 14 (3): 327-334.

APPENDIX

Descriptive output

APPENDIX A

Demographic, Socio–economic and proximate characteristics of study population and Dropouts from contraceptive use

Variables		Pattern of use		Total (Row %)
		Currently using	Dropout from contraceptive use	
Reason of last discontinuation(RLD)		515	828	1343
		38.3%	61.7%	100%
	Wanted more children	162	304	466
		34.8%	65.2%	100%
	Health concerns	142	185	327
		43.4%	56.6%	100%
	Wanted more eff.meth	61	0	61
		100%	0%	100%
	Side effects	16	24	40
		40%	60%	100%
	Other	134	315	449
		29.8%	70.2%	100%
Region(REGION)		515	828	1343
		38.3%	61.7%	100%
	Tigray	33	84	117
		28.2%	71.8%	100%
	Afar	6	20	26
		23.1%	76.9%	100%
	Amhara	43	150	193
		22.3%	77.7%	100%
	Oromiya	75	110	185
		40.5%	59.5%	100%
	Somali	6	3	9
		66.7%	33.3%	100%
	Ben-Gumz	22	64	86
		25.6%	74.4%	100%
	SNNP	46	81	127
		36.2%	63.8%	100%
	Gambela	29	48	77
		37.7%	62.3%	100%
	Harari	59	59	118
		50%	50%	100%
	Dire Dawa	29	49	78
		37.2%	62.8%	100%
	Addis Abeba	167	160	327
		51.1%	48.9%	100%
Type of place of residence(PLACE)		515	828	1343
		38.3%	61.7%	100%

	Urban	355	381	736
		48.2%	51.8%	100%
	Rural	160	447	607
		26.4%	73.6%	100%
Current age of respondent(AGE)		515	828	1343
		38.3%	61.7%	100%
	15-19	24	58	82
		29.3%	70.7%	100%
	20-34	366	553	919
		39.8%	60.2%	100%
	35-49	125	217	342
		36.5%	63.5%	100%
Heard FP on radio last12 months(HFP)		515	828	1343
		38.3%	61.7%	100%
	Yes	328	404	732
		44.8%	55.2%	100%
	No	187	424	611
		30.6%	69.4%	100%
Visited by FP worker last 12m(VFP)		515	828	1343
		38.3%	61.7%	100%
	Yes	58	98	156
		38.5%	61.5%	100%
	No	457	730	1187
		37.2%	62.8%	100%
Visited health facil. last 12m(VHF)		515	828	1343
		38.3%	61.7%	100%
	Yes	293	382	675
		43.4%	56.6%	100%
	No	222	446	668
		33.2%	66.8%	100%
Religion(RELIGION)		515	828	1343
		38.3%	61.7%	100%
	Other	8	12	20
		40%	60%	100%
	Protestant	61	112	173
		35.3%	64.7%	100%
	Moslem	111	194	305
		36.4%	63.6%	100%
	Orthodox	335	510	845
		39.6%	60.4%	100%
Women education(EDC)		515	828	1343
		38.3%	61.7%	100%
	Secondary and above	234	249	483
		48.4%	51.6%	100%
	Primer education	125	195	320
		39.1%	60.9%	100%
	No education	156	384	540
		28.9%	71.1%	100%
Number of living children(NLC)		515	828	1343
		38.3%	61.7%	100%
	3+	16	47	63

		25.6%	74.4%	100%
	1-2	402	498	900
		44.7%	55.3%	100%
	0	97	283	380
		25.5%	74.5%	100%

Logistic Regression Output using Enter and Forward method

APPENDIX B

Case Processing Summary

Unweighted Cases(a)		N	Percent
Selected Cases	Included in Analysis	1343	100.0
	Missing Cases	0	.0
	Total	1343	100.0
Unselected Cases		0	.0
Total		1343	100.0

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

Classification Table (a,b)

Observed			Predicted		
			Pattern of use		Percentage Correct
			Currently using	Currently dropout	Currently using
Step 0	Pattern of use	Currently using	0	515	.0
		Currently dropout	0	828	100.0
	Overall Percentage				61.7

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

Iteration History(a,b,c)

Iteration		-2 Log likelihood	Coefficients
		Constant	Constant
Step 0	1	1788.194	.466
	2	1788.170	.475
	3	1788.170	.475

a Constant is included in the model.
b Initial -2 Log Likelihood: 1788.170
c Estimation terminated at iteration number 3 because parameter estimates changed by less than .001.

Model Summary

Step	-2 Log likelihood	Cox & Snell R	Nagelkerke R Square

		Square	
1	1444.327(a)	.226	.307

a Estimation terminated at iteration number 20 because maximum iterations has been reached. Final model.

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	349.105	24	.000
	Block	349.105	24	.000
	Model	349.105	24	.000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	1439.066(a)	.229	.311

a. Estimation terminated at iteration number 20 because maximum iterations have been reached. Final solution cannot be found.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	10.329	8	.243

Contingency Table for Hosmer and Lemeshow Test

		Pattern of use = Currently using		Pattern of use = Currently dropout		Total
		Observed	Expected	Observed	Expected	Observed
Step 1	1	114	114.922	20	19.078	134
	2	81	86.179	54	48.821	135
	3	76	74.626	58	59.374	134
	4	67	60.801	67	73.199	134
	5	45	47.671	88	85.329	133
	6	45	38.805	90	96.195	135
	7	26	32.581	109	102.419	135
	8	29	26.504	103	105.496	132
	9	26	21.061	108	112.939	134
	10	6	11.850	131	125.150	137

Classification Table (a)

Observed			Predicted		
			Pattern of use		Percentage Correct
			Currently using	Currently dropout	Currently using
Step 1	Pattern of use	Currently using	273	242	53.0
		Currently dropout	137	691	83.5

Overall Percentage		71.8

a. The cut value is .500

Variables in the Equation

		B	S.E.	wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	REASON			15.585	4	.004			
	REASON(1)	-.225	.142	2.525	1	.112	.798	.605	1.054
	REASON(2)	-.590	.152	15.090	1	.000	.554	.411	.746
	REASON(3)	-22.058	5146.182	.000	1	.997	.000	.000	.
	REASON(4)	-.449	.339	1.758	1	.185	.638	.328	1.240
	Constant	.855	.103	68.680	1	.000	2.351		
Step 2(b)	REASON			19.769	4	.001			
	REASON(1)	-.263	.145	3.266	1	.071	.769	.578	1.022
	REASON(2)	-.691	.157	19.409	1	.000	.501	.369	.681
	REASON(3)	-22.006	5055.887	.000	1	.997	.000	.000	.
	REASON(4)	-.438	.347	1.590	1	.207	.645	.327	1.275
	PLACE(1)	-.970	.124	60.878	1	.000	.379	.297	.484
	Constant	1.452	.134	117.142	1	.000	4.270		
Step 3(c)	REASON			17.759	4	.001			
	REASON(1)	-.016	.153	.011	1	.917	.984	.729	1.329
	REASON(2)	-.605	.163	13.706	1	.000	.546	.397	.752
	REASON(3)	-22.131	4863.080	.000	1	.996	.000	.000	.
	REASON(4)	-.365	.359	1.034	1	.309	.694	.344	1.402
	PLACE(1)	-1.336	.136	96.944	1	.000	.263	.201	.343
	NLC			84.459	2	.000			
	NLC(1)	-.570	.356	2.559	1	.110	.566	.281	1.137
	NLC(2)	-1.455	.161	81.117	1	.000	.234	.170	.320
	Constant	2.589	.195	176.797	1	.000	13.316		
Step 4(d)	REASON			17.721	4	.001			
	REASON(1)	-.105	.158	.445	1	.505	.900	.661	1.226
	REASON(2)	-.656	.167	15.472	1	.000	.519	.374	.720
	REASON(3)	-22.217	4793.770	.000	1	.996	.000	.000	.
	REASON(4)	-.360	.367	.961	1	.327	.698	.340	1.433
	REGION			29.073	10	.001			
	REGION(1)	.742	.280	7.033	1	.008	2.099	1.213	3.631
	REGION(2)	1.320	.549	5.786	1	.016	3.745	1.277	10.982
	REGION(3)	.887	.255	12.113	1	.001	2.427	1.473	4.000
	REGION(4)	-.033	.230	.020	1	.886	.968	.616	1.519
	REGION(5)	-.380	.786	.233	1	.629	.684	.146	3.196
	REGION(6)	.848	.326	6.783	1	.009	2.336	1.234	4.424

	REGION(7)	.357	.258	1.910	1	.167	1.429	.861	2.369
	REGION(8)	.380	.304	1.564	1	.211	1.462	.806	2.650
	REGION(9)	.178	.248	.513	1	.474	1.194	.735	1.942
	REGION(10)	.448	.280	2.559	1	.110	1.566	.904	2.712
	PLACE(1)	-1.108	.166	44.521	1	.000	.330	.239	.457
	NLC			86.987	2	.000			
	NLC(1)	-.472	.360	1.718	1	.190	.624	.308	1.263
	NLC(2)	-1.504	.166	82.243	1	.000	.222	.161	.308
	Constant	2.196	.246	79.663	1	.000	8.992		
Step 5(e)	REASON			18.599	4	.001			
	REASON(1)	-.093	.158	.344	1	.558	.911	.669	1.243
	REASON(2)	-.672	.168	16.094	1	.000	.511	.368	.709
	REASON(3)	-22.241	4788.138	.000	1	.996	.000	.000	.
	REASON(4)	-.289	.366	.626	1	.429	.749	.366	1.533
	REGION			26.862	10	.003			
	REGION(1)	.752	.281	7.185	1	.007	2.122	1.224	3.678
	REGION(2)	1.287	.549	5.506	1	.019	3.623	1.236	10.616
	REGION(3)	.865	.255	11.476	1	.001	2.375	1.440	3.917
	REGION(4)	-.001	.231	.000	1	.995	.999	.635	1.570
	REGION(5)	-.372	.781	.227	1	.634	.689	.149	3.185
	REGION(6)	.823	.328	6.315	1	.012	2.278	1.199	4.328
	REGION(7)	.303	.260	1.359	1	.244	1.354	.814	2.252
	REGION(8)	.298	.305	.951	1	.329	1.347	.740	2.452
	REGION(9)	.279	.251	1.239	1	.266	1.322	.809	2.162
	REGION(10)	.438	.281	2.424	1	.120	1.550	.893	2.691
	PLACE(1)	-.995	.171	33.919	1	.000	.370	.265	.517
	HFP(1)	-.383	.141	7.339	1	.007	.682	.517	.899
	NLC			88.017	2	.000			
	NLC(1)	-.492	.361	1.861	1	.173	.611	.301	1.240
	NLC(2)	-1.517	.166	83.448	1	.000	.219	.158	.304
	Constant	2.356	.255	85.543	1	.000	10.553		
Step 6(f)	REASON			18.522	4	.001			
	REASON(1)	-.082	.158	.268	1	.605	.921	.675	1.257
	REASON(2)	-.669	.168	15.864	1	.000	.512	.369	.712
	REASON(3)	-22.274	4784.993	.000	1	.996	.000	.000	.
	REASON(4)	-.264	.367	.520	1	.471	.768	.374	1.575
	REGION			25.902	10	.004			
	REGION(1)	.731	.281	6.769	1	.009	2.077	1.198	3.601
	REGION(2)	1.198	.552	4.715	1	.030	3.312	1.124	9.762
	REGION(3)	.838	.256	10.718	1	.001	2.311	1.400	3.816
	REGION(4)	-.022	.232	.009	1	.925	.978	.621	1.541
	REGION(5)	-.495	.777	.407	1	.524	.609	.133	2.793
	REGION(6)	.810	.327	6.150	1	.013	2.248	1.185	4.264
	REGION(7)	.265	.261	1.035	1	.309	1.304	.782	2.173

	REGION(8)	.235	.309	.579	1	.447	1.265	.691	2.315
	REGION(9)	.249	.251	.979	1	.323	1.282	.783	2.099
	REGION(10)	.385	.284	1.844	1	.175	1.470	.843	2.565
	PLACE(1)	-.957	.172	31.020	1	.000	.384	.274	.538
	HFP(1)	-.369	.142	6.776	1	.009	.691	.523	.913
	VHF(1)	-.303	.131	5.384	1	.020	.739	.572	.954
	NLC			85.757	2	.000			
	NLC(1)	-.449	.362	1.540	1	.215	.638	.314	1.297
	NLC(2)	-1.493	.166	80.872	1	.000	.225	.162	.311
	Constant	2.484	.262	89.798	1	.000	11.992		
Step 7(g)	REASON			18.776	4	.001			
	REASON(1)	-.100	.159	.395	1	.529	.905	.663	1.236
	REASON(2)	-.683	.169	16.412	1	.000	.505	.363	.703
	REASON(3)	-22.290	4786.255	.000	1	.996	.000	.000	.
	REASON(4)	-.222	.368	.364	1	.546	.801	.389	1.647
	REGION			24.536	10	.006			
	REGION(1)	.692	.281	6.042	1	.014	1.997	1.150	3.467
	REGION(2)	1.231	.551	4.988	1	.026	3.424	1.163	10.085
	REGION(3)	.808	.256	9.951	1	.002	2.244	1.358	3.709
	REGION(4)	-.029	.232	.016	1	.901	.972	.617	1.530
	REGION(5)	-.524	.780	.451	1	.502	.592	.128	2.733
	REGION(6)	.765	.328	5.459	1	.019	2.150	1.131	4.086
	REGION(7)	.228	.262	.754	1	.385	1.255	.751	2.098
	REGION(8)	.215	.310	.480	1	.489	1.240	.675	2.277
	REGION(9)	.208	.252	.680	1	.410	1.231	.751	2.017
	REGION(10)	.354	.284	1.560	1	.212	1.425	.817	2.486
	PLACE(1)	-1.295	.231	31.377	1	.000	.274	.174	.431
	HFP(1)	-.709	.209	11.498	1	.001	.492	.327	.742
	VHF(1)	-.297	.131	5.160	1	.023	.743	.575	.960
	NLC			85.410	2	.000			
	NLC(1)	-.453	.362	1.569	1	.210	.636	.313	1.291
	NLC(2)	-1.485	.165	80.678	1	.000	.227	.164	.313
	HFP(1) by PLACE(1)	-.611	.277	4.852	1	.028	.543	1.070	3.171
	Constant	2.645	.273	93.678	1	.000	14.088		

a .Variable(s) entered on step 1: REASON.
b .Variable(s) entered on step 2: PLACE.
c .Variable(s) entered on step 3: NLC.
d .Variable(s) entered on step 4: REGION.
e .Variable(s) entered on step 5: HFP.
f .Variable(s) entered on step 6: VHF.
g .Variable(s) entered on step 7: HFP * PLACE .

Case wise List (a)

a. The case wise plot is not produced because no outliers were found.

APPENDIX C

Table 12 Result of diagnostic tests for outliers and influential value

	N	Minimum	Maximum
Normalized residual	1343	-2.97048	1.85971
Analog of Cook's influence statistics	1343	.00000	.41586
Leverage value	1343	.00184	.14929
DFBETA for constant	1343	-.03051	.01668
DFBETA for REASON(1)	1343	-.01309	.01539
DFBETA for REASON(2)	1343	-.01315	.01551
DFBETA for REASON(3)	1343	-.15553	.01988
DFBETA for REASON(4)	1343	-.09945	.09157
DFBETA for REGION(1)	1343	-.05176	.03303
DFBETA for REGION(2)	1343	-.24255	.15413
DFBETA for REGION(3)	1343	-.04729	.02965
DFBETA for REGION(4)	1343	-.03237	.03009
DFBETA for REGION(5)	1343	-.21707	.47711
DFBETA for REGION(6)	1343	-.07269	.05672
DFBETA for REGION(7)	1343	-.04529	.03439
DFBETA for REGION(8)	1343	-.06067	.06083
DFBETA for REGION(9)	1343	-.03962	.03231
DFBETA for REGION(10)	1343	-.05728	.03677
DFBETA for PLACE(1)	1343	-.02963	.02843
DFBETA for HFP(1)	1343	-.02285	.01918
DFBETA for VHF(1)	1343	-.00832	.00913
DFBETA for NLC(1)	1343	-.08966	.04535
DFBETA for NLC(2)	1343	-.01043	.02262
DFBETA for HFP(1) by PLACE(1)	1343	-.01835	.02362
Valid N (listwise)	1343		

OUTPUT FOR MULTILEVEL LOGISTIC REGRESSION

APPENDIX D: EMPTY MODEL

Model and Data Descriptions

Sampling Distribution = Bernoulli
Link Function = Logistic
Weight Variable = Weights
Number of Level-2 Units = 11
Number of Level-1 Units = 1343
Number of Level-1 Units per Level-2 Unit =
117 26 193 185 9 86 127 77 118 78 327

o=========o
| Results for the model without any random effects |
o=========o

Goodness of fit statistics

Statistic	Value	DF	Ratio
Likelihood Ratio Chi-square	1788.1703	1341	1.3335
Pearson Chi-square	1343.0000	1341	1.0015
Deviance	1788.1703		
Akaike Information Criterion	1792.1703		
Schwarz Criterion	1802.5756		

Estimated regression weights

Parameter	Estimate	Error	z -Value	P- Value
Intercept	0.0000	0.0000		
INTERCEP	-0.4748	0.0561	-8.4613	0.0000

o=========o
| Results for the model with fixed and random effects |
o=========o

Total number of (macro) iterations 10

Goodness of fit statistics

Statistic	Value	DF	Ratio
Likelihood Ratio Chi-square	1722.7951	1340	1.2857
Pearson Chi-square	1323.5265	1340	0.9877
Deviance	1722.7928		
Akaike Information Criterion	1726.7928		
Schwarz Criterion	1737.1982		

Estimated regression weights

Parameter	Estimate	Error	z -Value	P- Value
Incept	0.0000	0.0000		
INTERCEP	-0.5568	0.0572	-9.7413	0.0000

Deviance-based Chi-Square test for significance of random effects

NDF	Chi-Square	P Value
1	65.3774	0.0000

Estimated level 2 variances and covariance's

Parameter	Estimate	Error	z -Value	P- Value
Intercept/intercept	0.1631	0.0578	2.8209	0.0048

Level 2 covariance matrix

	Intercept
Intercept	0.163142

Level 2 correlation matrix

	Intercept
Intercept	1.000000

APPENDIX E: RANDOM INTERCEPT AND FIXED SLOPES VARIABLEs

o==========o
| Results for the model without any random effects
o==========o

Goodness of fit statistics

Statistic	Value	DF	Ratio
Likelihood Ratio Chi-square	1700.5699	1337	1.2719
Pearson Chi-square	1339.5472	1337	1.0019
Deviance	1700.5699		
Akaike Information Criterion	1712.5699		
Schwarz Criterion	1743.7859		

Estimated regression weights

Parameter	Estimate	Error	z- Value	P- Value
Intercept	0.6939	0.2170	3.1979	0.0014
PLACE	-0.8116	0.1263	-6.4267	0.0000
HFP	-0.3180	0.1246	-2.5517	0.0107
VHF	-0.3091	0.1171	-2.6403	0.0083
REASON	0.2650	0.1236	2.1440	0.0320
NLCM	0.1372	0.1299	1.0564	0.2908

o==========o
| Results for the model with fixed and random effects
o==========o

Total number of (macro) iterations 23

Goodness of fit statistics

Statistic	Value	DF	Ratio
Likelihood Ratio Chi-square	1684.7504	1336	1.2610
Pearson Chi-square	1324.9826	1336	0.9918
Deviance	1684.7433		
Akaike Information Criterion	1696.7433		
Schwarz Criterion	1727.9593		

Estimated regression weights (interpretation)

Parameter	Estimate	Error	z -Value	P- Value
Intercept	0.5760	0.2175	2.6486	0.0081
PLACE	-0.7345	0.1265	-5.8040	0.0000
HFP	-0.2976	0.1248	-2.3843	0.0171
VHF	-0.2997	0.1173	-2.5543	0.0106
REASON	0.2355	0.1238	1.9020	0.0572
NLC	0.1207	0.1302	0.9269	0.3540

Deviance-based Chi-Square test for significance of random effects

NDF	Chi-Square	P- Value
1	15.8266	0.0001

Estimated level 2 variances and covariance

Parameter	Estimate	Error	z -Value	P- Value
Intercept/intercept	0.0408	0.0182	2.2364	0.0253

Level 2 covariance matrix

	Intercept
Intercept	0.040767

Level 2 correlation matrix

	Intercept
Intercept	1.000000

APPENDIX F: RANDOM INTERCEPT AND RANDOM SLOPES VARIABLEs

o===o
| Results for the model without any random effects
o===o

Goodness of fit statistics

Statistic	Value	DF	Ratio
Likelihood Ratio Chi-square	1700.5699	1337	1.2719
Pearson Chi-square	1339.5472	1337	1.0019
Deviance	1700.5699		
Akaike Information Criterion	1712.5699		
Schwarz Criterion	1743.7859		

Estimated regression weights

Parameter	Estimate	Error	z- Value	P -Value
intcept	0.6939	0.2170	3.1979	0.0014
PLACE	-0.8116	0.1263	-6.4267	0.0000
HFP	-0.3180	0.1246	-2.5517	0.0107
VHF	-0.3091	0.1171	-2.6403	0.0083
REASON	0.2650	0.1236	2.1440	0.0320
NLC	0.1372	0.1299	1.0564	0.2908

o===o
| Results for the model with fixed and random effects
o===o

Total number of (macro) iterations 83

Goodness of fit statistics

Statistic	Value	DF	Ratio
Likelihood Ratio Chi-square	1649.8847	1331	1.2396
Pearson Chi-square	1300.7163	1331	0.9772
Deviance	1649.8803		
Akaike Information Criterion	1661.8803		
Schwarz Criterion	1693.0962		

Estimated regression weights (for interpret)

Parameter	Estimate	Error	z- Value	P- Value
intercept	0.5339	0.2181	2.4480	0.0144
PLACE	-0.7022	0.1270	-5.5287	0.0000
HFP	-0.3588	0.1253	-2.8623	0.0042
VHF	-0.2720	0.1183	-2.2991	0.0215
REASON	0.2521	0.1248	2.0198	0.0434
NLC	0.1411	0.1314	1.0739	0.2829

Deviance-based Chi-Square test for significance of random effects

NDF	Chi-Square	P Value
21	50.6896	0.0003

Estimated level 2 variances and covariance

Parameter	Estimate	Error	z- Value	P -Value
Intercept/intercept	0. 2148	0.0784	2.7397	0.0112
PLACE/intercept	-0.0283	0.0428	-0.6615	0.5083
PLACE/PLACE	0.0589	0.0363	1.6203	0.1052
HFP/intercept	0.0750	0.0498	1.5076	0.1317
HFP/PLACE	0.0121	0.0297	0.4084	0.6830
HFP/HFP	0.1043	0.0479	2.1762	0.0295
VHF/intercept	-0.1057	0.0614	-1.7219	0.0851
VHF/PLACE	-0.0565	0.0416	-1.3598	0.1739
VHF/HFP	-0.0966	0.0529	-1.8257	0.0679
VHF/VHF	0.2262	0.0900	2.5143	0.0119
REASON/intercept	-0.0480	0.0293	-1.6366	0.1017
REASON/PLACE	-0.0027	0.0161	-0.1657	0.8684
REASON/HFP	-0.0373	0.0212	-1.7545	0.0793
REASON/VHF	0.0604	0.0285	2.1189	0.0341
REASON/REASON	0.0244	0.0162	1.5058	0.1321
NLC/intercept	-0.0670	0.0411	-1.6298	0.1031
NLC/PLACE	-0.0248	0.0242	-1.0249	0.3054
NLC/HFP	-0.0493	0.0308	-1.6036	0.1088
NLC/VHF	0.1247	0.0511	2.4416	0.0146
NLC/REASON	0.0352	0.0187	1.8869	0.0592
NLCM/NLC	0.0740	0.0340	2.1783	0.0294

Level 2 covariance matrix

	Intercept	PLACE	HFP	VHF	REASON	NLC
Intercept	0.124807					
PLACE	-0.028329	0.058894				
HFP	0.075039	0.012116	0.104339			
VHF	-0.105734	-0.056512	-0.096606	0.226181		
REASON	-0.048006	-0.002671	-0.037277	0.060382	0.024421	
NLC	-0.067022	-0.024827	-0.049337	0.124679	0.035219	0.073969

Level 2 correlation matrix

	Intercept	PLACE	HFP	VHF	REASON	NLC
Intercept	1.000000					
PLACE	-0.330427	1.000000				
HFP	0.657575	0.154562	1.000000			
VHF	-0.629316	-0.489641	-0.628859	1.000000		
REASON	-0.869552	-0.070434	-0.738472	0.812459	1.000000	
NLC	-0.697544	-0.376151	-0.561593	0.963919	0.828649	1.000000

DECLARATION

I THE UNDERSIGNED, DECLARE THAT THIS THESIS IS MY ORIGINAL WORK IN PARTIAL FULFILLMENT FOR THE REQUIREMENTS FOR THE DEGREE OF MASTER OF STATSTICS. ALL THE SOURCES OF THE MATERIALS USED FOR THIS THESIS AND ALL PEOPLE AND INSTITUTIONS WHO GAVE SUPPORT FOR THIS WORK ARE FULLY ACKNOWLEDGED.

NAME: ESHETU KASSU----------

SIGNITURE_____

PLACE OF SUBMISSION -DEPARTMENT OF STATISTICS,
SCIENCE FACULTY ADDIS ABABA UNIVERSTY

DATE OF SUBMISSION _____

THIS THESIS WORK HAS BEEN SUBMITTED FOR EXAMINATION WITH MY APPROVAL AS A UNIVERSITY ADVISOR.

DR. EMMANUEL G/YOHANNES _____