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Addis Ababa University
Office of Graduate Program

Faculty of Science
Department of Statistics

FACTORS AFFECTING USE OF CONTRACEPTIVE METHODS AMONG MARRIED WOMEN IN ETHIOPIA

By
Getahun Adugna

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

July, 2008

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Approved by the Board of Examiners:

Fentaw Abegaz ....

Advisor **Signature**

Sileshi Fanta ....

Internal Examiner **Signature**

Ejigu Wencheko ....

External Examiner **Signature**

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Acknowledgement

This study would not have been in its final form without the help of various individuals.

I owe the deepest gratitude to my thesis advisor, Dr. Fentaw Abegaz, who starting from the very conception of the idea of its realization, has given me substantive advice and comments. His interest, valuable advice and encouragement in the completion of the study is most appreciated.

My special thanks are due to W/o Senait Seyoum, Head of Operations Department; W/o Tiebe Mesfin, Ethics officer and W/o Tsehay Kassa, Team leader of Duty free and Investment team, for their cooperation.

I have the highest regard for the staff of Duty free and Investment team in Ethiopian Customs Authority, Ato Abebaw Yitayeh, Ato G/Egziabher G/Tsadik, W/t Abnet Wondmagegn, W/o Tsion Admassu, W/t Kalehiwot Mekonnen, Ato Tesfaye Mekonnen and W/o Tagegn Belay for their heartful and friendly assistance during the time of learning and preparing this thesis.

Finally, I would like to thank my brothers Abebe Tesfa and Solomon Adugna and my uncle Ato Geremew Kassie for their cooperation.

Abstract

The increasing use of family planning methods seems to be the intermediate determinant which mostly influences the fertility decline in developing countries. Ethiopia is characterized by very different geographical realities and by strong regional heterogeneities. Large scale surveys often follow a nested structure of data because information is collected from different levels of hierarchy. It is thus necessary to elicit the inherent variations, which occur for a particular phenomenon among these different levels. The present study seeks to detect variations resulting from such nested structure in the case of contraceptive practice in Ethiopia, as well as to identify sociodemographic factors affecting the individual's behavior. Applying multilevel analysis, models are developed for current use of contraception. The study used data collected in the Ethiopian Demographic and Health Survey, 2005. The final multilevel model reflects the existence of significant variations in the mean effects of the predictors of current contraceptive practice at regional level. The study shows that running intensive family planning programs along with other awareness programs in those regions where the particular determinant of contraceptive use has been found to be not very effective.

List of Tables

Acronyms

EMPLOY	Employment status of woman
FP	Family Planning
HFPRADIO	Heard family planning on radio
VFPWORK	Visited by family planning worker
VHEFAC	Visited health facility
WOMEDU	Woman's education

CHAPTER-ONE

Introduction

1.1 Background

Ethiopia is one of the developing countries with high growth rate of population, high level of maternal and child mortality. According to the medium variant projection of the Central Statistical Authority (CSA), the population size of the country was estimated at about 71.1 million for the year 2004. The population growth rate of the country is among the highest in Sub-Sahara Africa, with 2.7 percent per annum projected for the year 2000-2005 (CSA, 1999). Women in the reproductive age group (15-49), constitute a substantial percent of the total female population. Furthermore the country has a youth age structure in which 40 percent of the population is below age 15. This indicates that there is considerable momentum for population growth.

One of the factors contributing to the present level of population growth is the prevalence of high fertility in the country. According to the 2000 Demographic and Health Survey (DHS), an Ethiopian woman will give birth on average to 5.9 children. Fertility in rural areas is 6.4 and it is nearly twice as large as in urban areas with 3.3. To overcome the problem of rapid population growth, some actions have been taken in the areas of fertility inhibiting factors.

Use of contraception is one of the most important proximate variables that affect the level of fertility in a population (Bongarts and Potter, 1983). The practice of contraception in a population is an aspect of development that is of great interest both to demographers, as a proximate determinant of fertility, and to family planning policy makers, as a measure of the coverage of their program. Other factors affecting the level of fertility are marriage, postpartum infecundability and induced abortion (Bongaarts, 1978). Of these proximate variables, contraception has the strongest effect on fertility in most developing countries.

Available evidences show that in a country where contraceptive use is wide spread, fertility is low. Based on 1992 World Fertility Survey (WFS) and Demographic and Health Survey (DHS) data, it is found that differences in the prevalence of contraceptive use explain about 92% of variation in fertility among 50 developing countries. Similarly, other researchers have found that the increasing use of effective family planning methods is a major reason for the recent rapid fertility decline in the developing nations (Population Report, 1992).

Various studies have indicated that prospects for continued fertility decline in developing countries depend heavily on continued increase in contraceptive prevalence rate. According to the United Nations medium-variant fertility projections, the total fertility rate is expected to decline from 3.7 children per woman in 1985-1990 to 3.0 children in 2000-2005 and 2.4 children in 2020-2025. It is estimated that, in order to realize such fertility decline, contraceptive prevalence in developing regions will have to rise from 45% in 1985 to 71% by the year 2025 (UN, 1989: 2). However, the pace of growth in contraceptive prevalence will have to increase markedly in Africa where the practice of contraception is hardly known.

While present day contraceptive technology and family planning efforts are designed mainly to influence the level of fertility, the impact of such efforts is not, however, so strongly felt in most of the less developed countries like Ethiopia. Like other Sub-Saharan African countries, Ethiopia is known to have high fertility and low contraceptive prevalence rates. According to the key findings of the 2000 Demographic and Health Survey in Ethiopia, awareness about contraceptive methods is relatively high in Ethiopia, with 86 percent of currently married women age 15-49. However, the contraceptive prevalence rate among currently married women is low (8 percent) (Dilnesaw Asrat, 1995).

Among the several mechanisms through which contraceptive use is raised to a level where it can positively affect demographic trends is improving the status of women. The effectiveness of family planning programs in Ethiopia depends on, among other things, service accessibility, attitudinal factors and the socioeconomic settings within which the program operates. Hence it is crucial to explore the factors directly affecting women's ability and willingness to use contraception and the extent to which such ability and willingness are affected by their socioeconomic status.

In order to increase the effectiveness of family planning programs and enhance the pace of growth in contraceptive prevalence rate in the country, identification of some of the factors which directly inhibit the use of contraception will be of paramount importance.

Beyond the ultimate objective of fertility reduction, many countries support access to, and knowledge of, family planning methods on the grounds of health improvements. It is believed that wide spread usage of contraception by women would greatly reduce the high number of unsafe and illegal abortion as well as increase women's status to play a more creative role in the family.

Needless to say that, if it were not for the ignorance about modern contraceptive usage to prevent unintended (unwanted) pregnancy, a large number of maternal deaths could have been prevented. Family planning information and contraceptive use help families make decisions about the number of children they want and when they want to have them. Family planning program can contribute for the significant reduction in infant and child mortality through increased birth spacing, and this clearly demonstrates the importance of wide spread utilization of contraception by women throughout the country. However, use of contraception by women in most of the less developed countries like Ethiopia is not wide spread for various reasons.

This study investigates factors affecting the practice of contraception, and examines the extent to which these factors are related to women's use of contraceptive methods in Ethiopia. An attempt is made to see if there are differences in the prevalence of contraceptive use among women in selected demographic and socioeconomic subgroups as well as and the effect of factors on the use of contraception using multi-variate statistical techniques such as logistic regression and multilevel logistic regression.

1.2 Objective

The objective of this study is:

- to investigate factors affecting the use of contraception in Ethiopia.
- to determine the prevalence of contraceptive use among women in selected demographic and socio-economic subgroups.
- to investigate regional differences in the use of contraceptive methods.

-to identify regional level determinants of contraceptive use.

1.3 Applications of the results

The result of the study may be considered as information by family planning workers and policy makers to enhance the awareness of the society about factors that affect the use of contraceptives. The result may also be used to focus on improving the status of women that will lead to an increase in the use of contraceptives, to develop specific programs for each region that further increase use of contraceptives and finally used as a source of information to other researchers in the future.

CHAPTER TWO

Literature review

Comparative studies conducted in DHS-surveyed countries during 1986-1989 have shown that despite the relatively high fertility rate in Africa, women's feeling about desired future fertility indicate that in several countries a decline in fertility could possibly happen. In deed, in some African countries (e.g. Kenya, Mali, Togo and Uganda) the projected declines 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 et.al., 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 conception voluntarily by applying contraceptives. A problem of continuing interest in the field of demographic research has been understanding the reasons why, in any society, some couples use contraception to space births and limit family size, and others do not. A number of scholars have been concerned with the specific conditions in which individuals or couples will apply contraception as a means of limiting or spacing births. Thus, based on the available literature, overview of some possible determinants of women's contraceptive use will be highlighted in the following section.

2.1 Contraceptive prevalence rate

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, cited in NCR, 1993). Although prevalence levels are higher in the industrialized than in the developing world (75 percent versus 51 percent), it is note worthy that more than half of the women of reproductive age in developing countries currently use some form of contraception (Population Reference Bureau,1992 and UN, 1993 cited in NRC, 1993).

The level of current contraceptive use greatly varies among the developing regions, from an estimated 10 percent of couples using contraception in Africa to 50 percent in Asia and 56 percent in Latin America. The survey made both in developed and in developing countries envisages that the main methods are surgical contraceptive sterilization, which is responsible for an estimated 36 percent of world contraceptive practice, IUD (19%), oral contraceptives or pill (15%), condoms (10%), periodic abstinence or rhythm (7%) and withdrawal (8%). A variety of other methods make up the remaining (5%) of the use (UN, 1989). In Ethiopia, the contraceptive prevalence rate for married women who are currently using family planning method is about 15 percent. Almost all of these users are using modern methods (14%). The most widely used method is injectables (10%) followed by pill (3%). More specifically, the population policy was targeted to reduce the total fertility rate from 7.7 children per woman in 1990 to 4.0 children per woman in 2015 and to increase the prevalence of contraceptives from 4 percent in 1990 to 44 percent in 2015. (CSA and ORC Macro, 2005).

2.2 Demographic characteristics

It has been observed that women are less likely to contracept 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). Studies in Ethiopia based on 2005 EDHS data indicated that among currently married women ever use of any method rises from 16 percent among those age 15-19, peaks at 27 percent among those age 40-44 before falling markedly to 14 percent among the oldest age group.

A number of studies have found positive association between number of living children and women's contraceptive use. For African and Asian countries, some studies have found relatively highest contraceptive use mostly among women with four or more children (Sathara and Chitambara 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%).

2.3 Socioeconomic characteristics

Many studies revealed that education is a very strong factor that positively influences women to practice contraception. For instance, in Sub-Saharan Africa, the contraceptive use prevalence rate was high among educated women than uneducated women (Curtis and Neitzel, 1996). Education increases women's knowledge and exposure to mass media. Mass media can influence fertility attitudes and behavior by publicizing non-traditional life styles, including smaller families, and by creating a climate conductive to behavioral change (Martin and Juarez, 1995).

Educated women enhance their status and their decision making capacity at all spheres of life. Improvements in the status of women relative to men are critical elements and possibly even necessary conditions for significant fertility declines to occur in developing countries. This has been a widely accepted view within the international population field for many years. The International Conference on Population and Development held in Cairo in 1994 emphasized that improving the status of women also enhances their Capacity at all levels in all spheres of life, especially in the area of sexuality and reproduction. This, in turn, is essential for long term success of population progmmes (United Nations, 1994).

In relation to Ethiopia, a study based on 2005 EDHS indicated a variation of contraceptive use by educational level of women. The variation by level of education are 10 percent of women with no education, 23 percent of women with primary education, and 53 Percent with secondary and higher levels of education.

In all corners of the world, it is believed that the contraceptive prevalence rate of urban women is higher than that of their rural counterparts. The difference between urban and rural prevalence is highest in sub-Sahara Africa, where the rate is more than twice as high among urban than rural married women (Curtis and Neitzlel, 1996). 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 rural areas (42% versus 11%). (CSA and ORC Macro, 2006). This urban-rural differential could be explained by the fact that couples living in urban areas are most likely to be close 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.

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 and Tambashe, 1994). Working women are more likely to have direct access to financial resources, be in contact in people other than immediate family and generally be more knowledgeable about the world out side the home (Kishor and Neitzal, 1996). This may affect their fertility and contraceptive behavior.

Disseminating information through the mass media increases awareness to 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. In most developing countries, especially in sub-Sahara Africa, promoting family planning through radio and television is an important means of raising awareness, improving knowledge, and motivating use of modern contraceptive methods. In most countries regular exposure to mass media has a positive effect on use of contraceptive.

A DHS study on Kenya that was conducted in 1998 reveals that women's exposure to family planning messages in the mass media, their use of contraceptive and their desire for smaller families were closely associated. Indeed, women who were more exposed to family planning messages wanted smaller families and used contraception more than other women (Gupta, et al., 2003, Robey, et.al.1996). In relation to Ethiopia, a study based on 2005 EDHS indicated family planning information is largely disseminated through radio with limited broadcast through television or print media. For example, 29 percent of women heard about family planning on the radio compared with only 11 percent of women who got family planning information from the television and 8 percent who got such information from newspapers or magazines.

Most of the studies revised and presented in this chapter used different statistical methods like descriptive statistics, bivariate analysis and logistic regression. Likewise in our study we have used descriptive statistics and logistic regression to see the effects of those factors on contraceptive use. We used multilevel logistic regression to see the regional difference on use of contraception and differential effects of selected factors on use of contraception at region levels.

CHAPTER-THREE

Data and Methodology

3.1 The Data

The target population of this study is married women in the reproductive age group 15-49 living in Ethiopia. The 2005 Ethiopia Health and Demographic Survey (2005 EDHS) is the source of data. Respondents for this survey were a national representative sample of women in the reproductive age group 15-49. The Demographic and Health Survey (DHS) conducted in 2005 used a stratified two-stage cluster sample design to collect nationally representative samples of women of reproductive age (15-49). In the 2005 EDHS, a representative sample of approximately 14,500 women from 540 clusters was selected. Among these women, 8339 are married, which is the sample size considered in this study

In this survey information were collected from respondents on fertility, family planning behavior, background characteristics of respondents and other variables. The survey was intended to provide estimates of key population and health indicators, including fertility and mortality rate for the country as a whole. This study attempts to identify individual and regional level determinants of contraceptive use using multilevel techniques.

The response variable considered is pattern of contraceptive use, that is, use or non-use of contraception. The explanatory factors/variables include characteristics of the women and the kind of the family planning facilities. The explanatory variables for this study have been chosen to reflect the factors that might be expected to be associated with 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.

Table 1: Description of Variables included in the Analysis

Variable Name		Categories
Dependent Variable		
Pattern of use	Y_1	0=Currently not using contraceptives 1=Currently using contraceptives
Independent Variables		
Age of Woman	X_1	1=15-19 2=20-34 3=35-49
Woman's Education level	X_2	0= primary or illiterate 1=above primary
Employment status	X_3	0=Not employed 1=Employed
Region	X_4	1=Tigray 2=Afar 3=Amhara 4=Oromiya 5=Somali 6=Ben-gumuz 7=SNNP 12=Gambela 13=Harari 14=Dire Dawa

		15=Addis Ababa
Religion	X_5	1=Others 2=Protestant 3=Muslim 4= Coptic Orthodox
Place of Residence	X_6	1=Urban 2=Rural
Number of Living Children	X_7	0= no child 1=1-4 2=5 and more
Heard FP on radio last months	X_8	0=No 1=Yes
Visited by FP worker during the last 12 months	X_9	0=No 1=Yes
Visited health facility during the last 12 months	X_{10}	0=No 1=Yes
Partner's occupation	X_{11}	0=has no work 1=Agriculture 2=Non-Agriculture
Partner's education	X_{12}	0=No education 1=primary 2=secondary and higher

FP =Family Planning

3.2 Methods for Data Analysis

3.2.1 Logistic Regression Analysis

3.2.1.1 Introduction

Suppose the response variable for the i^{th} individual is represented by a random variable Y_i with the two possible values coded by 1 and 0. We adopt the generic representation $Y_i=1$ as a "success" and $Y_i=0$ as a "failure". The logit transformation of success probability, P_i of the i^{th} individual can be modeled as a linear combination of p explanatory variables $X_{1i}, X_{2i}, \ldots, X_{pi}$, so that:

$$\text{logit}\,(P_i) = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \ldots + \beta_p X_{pi}\,.$$

where $\beta_0, \beta_1, \beta_2, \ldots, \beta_p$ are the model parameters. The above relation can be given as

$$P_i = P\,(Y_i = 1 \mid X_1, X_2, \ldots, X_p) = \frac{e^{\eta_i}}{1+e^{\eta_i}}\,,$$

where $\eta_i = \beta_0 + \sum_{j=1}^{p} \beta_j X_{ji}\,,$

with further rearrangement we obtain the odds of success

$$\text{Odds}\,(Y_i = 1) = \frac{Pi}{1-Pi} = e^{\eta_i}\,.$$

3.2.1.2 Parameter Estimation

In order to fit the model to the data, the parameters of the model have to be estimated. The widely used method of estimation in logistic regression is the maximum likelihood method. The main concept underlying maximum likelihood estimation is that of finding values of parameters that maximize the likelihood function under the observed data. The likelihood function is given by

$$\mathrm{L} = \prod_{i=1}^{n} P_i^{y_i}\left(1-P_i\right)^{1-y_i} = \prod_{i=1}^{n}\left(\frac{e^{\eta_i}}{1+e^{\eta_i}}\right)^{y_i}\left(\frac{1}{1+e^{\eta_i}}\right)^{1-yi}$$

Taking the natural logarithm of both sides yields

$$ln\mathrm{L} = \sum_{i=1}^{n} y_i \ln\left(\frac{e^{\eta_i}}{1+e^{\eta_i}}\right) + \sum_{i=1}^{n}\left(1-y_i\right)\ln\left(\frac{1}{1+e^{\eta_i}}\right)$$

To find estimates of of the parameters $\beta_0, \beta_1, \beta_2, \ldots, \beta_p$ that maximizes *ln*L we differentiate *ln*L with respect to each component of the parameters and set the resulting $(p+1)$ equations to zero. Therefore, the estimates will be obtained by maximizing using a numerical iterative method (Agresti, 1996).

3.2.1.3 Tests for Goodness of fit

The Hosmer - Lemeshow Chi-Square test of goodness of fit is recommended for overall fit of a logistic regression model. 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. Under the null hypothesis the Hosmer-Lemeshow test statistics $\hat{C}$ follows a chi-square distribution with 8 degrees of freedom, that is,

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

In the above expression 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, where

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

$$\bar{P}_k = \sum_{j=1}^{n_k'} \frac{m_j \hat{p}_j}{n_k'},$$

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

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

We would like to pointout that detail discussions on logistic regression can be found in Agresti (1996) among others.

3.2.2 Multilevel models

3.2.2.1 Introduction

Multilevel modelling require the measurement of data on at least two levels of a system. Here we present the discussion of multilevel modelling based on two levels, that is individuals are in Level-1 and they are nested within groups (Level-2). However, without loss of generality, the discussion can be extended to more than two levels. The basic idea of multilevel analysis is that data sets with a nesting structure that includes unexplained variability at each level of nesting are usually not adequately represented by a single level analysis. Multilevel models are generally used to analyze data that have a hierarchical structure. An integral aspect of multilevel models is the ability to separate the variation in the response of interest into variation attributable to individual level factors and that is attributable to higher level contextual factors (Rice and Leyland, 1996).

The advantage of using multilevel modeling is that it takes the hierarchical structure of the data into account by specifying random effects at each level of analysis, and thus results in a more conservative inference for the aggregate effect. Multilevel modelling provides the opportunity to study variation at different levels of the hierarchy. Such a model can also include separate regression coefficients at different levels of the hierarchy that have no meaning without recognition of the hierarchical structure of the population.

3.2.2.2 Multilevel logistic regression

3.2.2.2.1 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 (in this case, individuals) are independent in the sense that variables affecting contraceptive use have the same effect in all groups. Multilevel modeling relaxes this assumption and allows the effects of these variables to vary across groups. For the i^{th} individual in the j^{th} group, observe a binary response,

$$Y_{ij} = \begin{cases} 1, & \text{for contraceptive user individual } i \text{ in the group } j \\ 0, & \text{otherwise} \end{cases}$$

where

$Y_{ij} \mid P_{ij} \sim \text{Bernoulli}(P_{ij})$, with $P_{ij} = P(Y_{ij} = 1)$, and

$$Y_{ij} = P_{ij} + \varepsilon_{ij} \quad \text{...(1)}$$

where ε_{ij} is the individual error term .

$$\log it(P_{ij}) = \log\left(\frac{P_{ij}}{1-P_{ij}}\right) = X_i^T \beta_j \quad \text{.. (2)}$$

$$\text{with } X_i = \begin{pmatrix} 1 \\ X_{1ij} \\ X_{2ij} \\ . \\ . \\ . \\ X_{pij} \end{pmatrix} \quad \text{and} \quad \beta_j = \begin{pmatrix} \beta_{0j} \\ \beta_{1j} \\ \beta_{2j} \\ . \\ . \\ . \\ \beta_{pj} \end{pmatrix}$$

X_{mij} (m=1, 2, …, p) represents measurements of the m^{th} explanatory variable for the i^{th} individual in the j^{th} group, X_i represents measurements on individual level variables; β_j consists of p+1 regression coefficients (specific to the j^{th} group).

3.2.2.2.2 Two level empty logistic regression model

The simplest case of the hierarchical linear model is the random effect analysis of variance model, in which the explanatory variables are not included in the model. This model contains only 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, β_0, a random effect at the group level, U_{oj}, and a random effect at the individual level ε_{ij} as given by (1),

$$\text{logit}(P_{ij}) = \beta_0 + U_{oj} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

The random variables U_{oj} are assumed to have a mean of zero and variance σ_0^2. In the context of multilevel modeling, (3) is called the two-level empty model, because it does not contain an explanatory variable. It is important because it provides the basic partition of the variability in the data between the two levels

3.2.2.2.3 Two level random intercept logistic regression models

Consider explanatory variables measured at individual level. A first step towards modeling between group variability is to let the intercept vary between groups.

The multilevel model with p explanatory variables X_{ij} is given by

$$\text{logit}\,(P_{ij}) = \beta_{0j} + \beta_1 X_{1ij} + \dots + \beta_p X_{pij} \quad \dots\dots\dots\dots (4)$$

To reduce the unexplained variability, we assume the intercept term to vary among groups, β_{0j}. That is, the varying intercept is the sum of general mean β_0 and random effect at group level, U_{oj}.

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

Further, we assume fixed regression coefficients for each explanatory variables, β_1, $\beta_2, \dots, \beta_p$. Then, the two level random intercept with p explanatory variables given in (4) can be expressed as

$$\text{logit}\,(P_{ij}) = \beta_0 + \sum_{l=1}^{P} \beta_l X_{lij} + U_{oj} \quad \dots\dots\dots\dots (5)$$

The parameters can be interpreted as the change in the response variable for one unit increase in the value of X_l (l =1, ..., p) keeping all other explanatory variables fixed.

For model (5), $\beta_0 + \sum_{l=1}^{P} \beta_l X_{lij}$ is called the fixed part of the model, because the coefficients are fixed (i.e., not stochastic). The remaining part, U_{oj} is called the random part of the model.

It is again assumed that the random effect U_{oj} has zero mean and variance σ_0^2 given the values of the explanatory variables. A somewhat less crucial assumption is that the random effect is drawn from normally distributed population.

3.2.2.2.4 Two level random coefficient logistic regression model

The unexplained variability in single-level multiple logistic 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 $X_1, X_2, \ldots, X_p$. At the within group level, i.e., for the individuals, the model is a regression model with p variables,

$$\text{logit}(P_{ij}) = \beta_{0j} + \beta_{1j}X_{1ij} + \ldots + \beta_{pj}X_{pij} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(6)}$$

where all the regression coefficients $\beta_{0j}, \beta_{1j}, \ldots\ldots, \beta_{pj}$ are assumed to vary randomly between the groups. Thus, the varying regression coefficients are given by

$$\beta_{lj} = \beta_l + U_{lj}, \quad l = 0, 1, 2, \ldots, p \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(7)$$

Substitution of (7) into (6) and rearranging terms yields the model

$$\text{logit}(P_{ij}) = \beta_0 + \sum_{l=1}^{P} \beta_l X_{lij} + U_{0j} + \sum_{l=1}^{P} U_{lj} X_{lij} \ldots\ldots\ldots\ldots\ldots\ldots(8)$$

As a result, from equation (8) $\beta_0 + \sum_{l=1}^{P} \beta_l X_{lij}$ is the fixed part and $U_{0j} + \sum_{l=1}^{P} U_{lj} X_{lij}$ is the random part of the model.

The groups are now characterized by $p+1$ random coefficients U_{0j} to U_{pj}. These random coefficients are assumed independent between any two groups, but may be correlated within groups. It is also assumed that the vector ($U_{0j}, \ldots, U_{pj}$) is independent of the level-one residuals ε_{ij} and that all random components have population means zero, given the values of all explanatory variables. It is also assumed that ($U_{0j}, \ldots, U_{pj}$) has a multivariate normal distribution with a constant covariance matrix given by

$$\begin{aligned} &Var(U_{lj}) = \sigma_l^2, l = 0,1,\ldots, p \\ &Cov(U_{lj}, U_{kj}) = \sigma_{lk}, l \neq k = 0,1,\ldots, p \end{aligned} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(9)$$

3.2.2.3 Testing heterogeneity of proportions

The first logical step in multilevel analysis is to test whether there are indeed systematic differences between the groups. There are several ways of testing heterogeneity of group proportions. We consider the test of heterogeneity of proportions that is proposed by Commenges and Jacqmin (1994). The test statistic is

$$T=\frac{\sum_{j=1}^{N}\left\{n_j^2\left(\bar{Y}_{.j}-\hat{P}\right)^2\right\}-M\hat{P}\left(1-\hat{P}\right)}{\hat{P}\left(1-\hat{P}\right)\sqrt{2\sum_{j=1}^{N}n_j\left(n_j-1\right)}},$$

where n_j = number of individuals in j[th] group

N= number of groups

$$M=\sum_{j=1}^{N}n_j$$

$$\hat{P}=\frac{1}{M}\sum_{j=1}^{N}\sum_{i=1}^{n_j}Y_{ij} \text{ and}$$

$$\bar{Y}_{.j}=\frac{1}{n_j}\sum_{i=1}^{n_j}Y_{ij}$$

Large values of this statistic are an indication of heterogeneous proportions. This statistic can be tested in a standard normal distribution.

The theoretical advantage of this test over the chi-squared test given in Snijders and Bosker (1999) is that it is more powerful to test randomness of the observations against the empty model, and the practical advantage is that it can be applied whenever there are many groups, even with small group sizes, provided that no single group dominates.

3.2.2.4 Parameter Estimation

Consider the random coefficient logistic regression model given by

$$\text{logit}\,(P_{ij}) = \beta_0 + \sum_{l=1}^{p} \beta_l X_{lij} + \sum_{l=1}^{p} U_{lj} X_{lij} + U_{0j} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (10)$$

where the vector of random coefficients (U_{0j}, U_{1j}, ..., U_{pj}), in most applications is assumed to have a multivariate normal distribution with mean zero and covariance matrix D as given by equation (9).

This software LISREL is used for analyzing the data in the present study employed the method of parameter estimation using Iterative Generalized Least Square (IGLS) algorithm and estimate the variance-covariance of the random coefficients.

3.2.2.5 Testing the significance of parameters

The null hypothesis

$$H_0 : \beta_l = 0 \qquad \text{Vs} \qquad H_1 : \beta_l \neq 0 \qquad l = 0, 1, 2, \ldots, p$$

can be tested by using the test statistic

$$Z = \frac{\hat{\beta}_l}{S.E\left(\hat{\beta}_l\right)} ,$$

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

3.2.2.6 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 larger 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. This type of test can be applied to parameters of the fixed as well as of the random part.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Background Characteristics

In this study, we have examined the variation of pattern of contraceptive use with socio-demographic characteristics. Table 2 shows selected socio-demographic characteristics of the 8339 currently married women included in the survey. The survey sample was intended to be representative of the country as a whole. The country level use of contraceptive is calculated to be 17.2 percent among currently married women.

Among the respondents who have completed at least primary level of schooling 47.4 and 52.6 percents were current non-users and users of contraception, respectively.

Contraceptive use has also been examined according to religion. As it can be seen from Table 2; among Orthodox Christians 25.2 and 74.8 percent were current users and non-users of contraception. Among Protestants, 13.5 and 86.5 percent were current users and non-users of contraception. Moreover, 10.5 and 8.0 percent among Muslims and "Others" were current users of contraception, respectively. As these results revealed, relatively the highest proportion of current contraceptive use was observed among the Orthodox Christians and the lowest proportion was observed among the group "Others".

Table 2: Percentage of married women currently using contraceptives, according to selected background characteristics

Variables	Currently using Contraceptives				Number
	No		Yes		
	No	(%)	No	(%)	
Educational attainment					
Primary or illiterate	6426	87.7	901	12.3	7327
above primary	480	47.4	532	52.6	1012
Age of Women					
15-19	617	89.6	72	10.4	689
20-34	3846	80.9	908	19.1	4754
35-49	2447	84.5	449	15.5	2896
Region					
Tigray	646	85.3	111	14.7	757
Afar	578	95.7	26	4.3	604
Amhara	1077	84.7	195	15.3	1272
Oromiya	1239	86.5	193	13.5	1432
Somali	476	98.6	7	1.4	483
Ben-Gumz	534	87.1	79	12.9	613
SNNP	1160	87.3	169	12.7	1329
Gambela	399	81.9	88	18.1	487
Harari	319	68.9	144	31.1	463

Harari

Dire Dawa	260	64.5	143	35.5	403
Addis Ababa	220	44.4	276	55.6	496
Religion					
Orthodox	2664	74.8	897	25.2	3561
Protestant	1182	86.5	185	13.5	1367
Muslim	2797	89.5	328	10.5	3125
Others	263	92.0	23	8.0	286
Number of living children					
0	734	89.4	87	10.6	821
1-4	4039	80.5	978	19.5	5017
5 and more	2136	85.4	365	14.6	2501
Heard family planning on radio last months					
No	5455	89.7	626	10.3	6081
Yes	1452	64.3	806	35.7	2258
Visited health facility during the last 12 months					
No	5202	88.4	683	11.6	5885
Yes	1703	69.4	751	30.6	2454
Visited by family planning worker in thelast 12 months					
No	6454	83.6	1266	16.4	7720
Yes	452	73.0	167	27.0	619

Employment Status					
Not working	5361	85.6	902	14.4	6263
Working	1549	74.6	527	25.4	2076
Type of place of residence					
Urban	841	52.9	748	47.1	1589
Rural	6068	89.9	682	10.1	6750
Partner's occupation					
Had no work	65	87.8	9	12.2	74
Agriculture	5655	90.7	580	9.3	6235
Non-Agriculture	1188	58.5	842	41.5	2030
Partner's education					
No education	4488	91.7	406	8.3	4894
Primary	1614	79.8	409	20.2	2023
Secondary and higher	806	56.7	616	43.3	1422

It is evident that place of residence is related to fertility and contraceptive behavior of women. Relatively higher proportions of current contraceptive use was observed among the urban dwellers. Thus, among women who reside in urban areas 47.1 percent and only 10.1 percent of women in rural areas were current users of contraceptives. On the other hand, among the urban dwellers 52.9 percent and among the rural dwellers majority of the respondents, 89.9 percent were non-users of contraception.

Studies conducted in Sub-Saharan countries revealed that younger women in the age group 15-19 are less likely to use contraception than their counterparts in the age group 20-34 (Bertrand, 1993). Among women in the youngest age group 15-19 the proportion of current users was 10.4 percent and among women in the age group 20-34 it was 19.1 percent. The proportion of current users among women in the age group 35-49 was 15.5 percent.

Table 2 also shows the status of current contraceptive use of women by number of living children. Accordingly, 10.6 percent of current users and 89.4 percent of non-users observed among women who have no child. Among women with one to four living children 19.5 percent of current users and 80.5 percent of non-users were observed. Women with five or more living children constituted of 14.6 percent of current users and 85.4 percent of non-users. The low contraceptive prevalence rate among the respondents who have no children may reflect the desire among the newlyweds for children soon after marriage or the continued desire for at least one child in the early reproductive years.

Family planning fieldworker contact is an important motivational means which can be used when change in contraceptive behavior of a population is desired. Table 2 shows visit of fieldworker is related to contraceptive use. About 16.4 percent of married women who were not visited by family planning worker in the last 12 months before the survey were using contraceptive, while 27.0 percent of women who were visited by family planning worker used contraceptives. Women who visited a health facility in the last 12 months before the survey have higher proportion of using contraceptive than women who did not visit.

Employment status of women is one indicator of women's status which can affect contraception behavior. Among women who have no work the highest proportion

(85.6 %) were non-users of contraception and only 14.4 percent reported that they were using contraceptives. Among the respondents who were employed 74.6 percent were non-users and 25.4 percent were reported that they were current users of contraception.

It is believed that women's exposure to family planning messages on radio may enhance use of contraception. As can be seen from Table 2, about 10.3 percent of women who did not hear family planning messages on the radio in the last months before the survey were users of contraceptives. About 35.7 percent of the married women who heard family planning messages on the radio were also users of contraceptives.

4.2. Logistic Regression Analysis

In order to assess the relative importance of each predictor of contraceptive we have used logistic regression analysis with forward stepwise variable selection procedure. In this study, "Success" stands for the outcome that the pattern of use is currently using contraception. To compute the odds of contraceptive use for any category, we always need to have a reference category. SPSS package takes automatically either the last (in order of coding) or the first category as a reference category. Then the odds of success for any category will be interpreted in relation to the reference category selected.

The results of the logistic regression are provided in Table 3. The table shows the parameter estimates of the model with best fit together with related statistics from the logistic regression model that predict the pattern of use of contraceptives of individual and the variables. The logistic regression procedure revealed the significant factors that are found to affect the use of contraception. These are "number of living children", "age", "employment status", "region", "religion", "education", "place of residence", "visited health facility", "visited by family planning worker", "heard family planning on radio", "partner's education" and "partner's occupation"

.

Table 3: Estimates for the logistic regression model

Covariates Sub groups	$\hat{\beta}_j$	S.E ($\hat{\beta}_j$)	Wald	df	Sig.	Exp $\hat{\beta}_j$)	95% CI for Exp $\hat{\beta}_j$)	
							Lower	Upper
Partner's education			39.475	2	.000*			
No education	-.474	.116	16.781	1	.000*	.622	.496	.781
Primary	.066	.106	.393	1	.530	1.068	.869	1.314
Secondary and higher(rc)	–	–	–	–	–	–	–	–
Religion			38.778	3	.000*			
Others	-.747	.243	9.489	1	.002*	.474	.294	.762
Protestant	-.551	.116	22.532	1	.000*	.576	.459	.724
Muslim	-.441	.093	22.533	1	.000*	.643	.536	.772
Orthodox (rc)	–	–	–	–	–	–	–	–
Education(primaryorilliterate)	-.451	.110	16.834	1	.000*	.637	.514	.790
above primary (rc)	–	–	–	–	–	–	–	–
Partner's occupation			44.124	2	.000*			
Had no work	-1.208	.385	9.867	1	.002*	.299	.141	.635
Agriculture	-.714	.116	37.848	1	.000*	.490	.390	.615
Non-agriculture (rc)	–	–	–	–	–	–	–	–

Place of residence (Urban)	.541	.128	17.841	1	.000*	1.717	1.336	2.207
Rural (rc)	–	–	–	–	–	–	–	–
Region			77.913	10	.000*			
Tigray	-5.06	.169	8.991	1	.003*	.603	.433	.839
Afar	-1.256	.244	26.392	1	.000*	.285	.176	.460
Amhara	-0.177	.154	1.329	1	.249	.838	.620	1.132
Oromiya	-0.386	.149	6.751	1	.009*	.680	.508	0910
Somali	-2.331	.409	32.443	1	.000*	.097	.044	.217
Ben-Gumz	-0.263	.179	2.155	1	0142	.769	.541	1.092
SNNP	-0.394	.158	6.249	1	.012*	.674	.495	.918
Gambela	0.184	.182	1.019	1	.313	1.202	.841	1.719
Harari	-0.136	.160	0.717	1	.397	.873	.638	1.195
Dire Dawa	-0.031	.160	0.038	1	.846	.969	.708	1.327
Addis Ababa (rc)	–	–	–	–	–	–	–	–
Visited health facility (No)	-.681	.070	94.141	1	.000*	.506	.441	.581
Yes (rc)	–	–	–	–	–	–	–	–
Employmentstatus(Unemployed)	-.277	.074	14.122	1	.000*	.758	.656	.876
Employed (rc)	–	–	–	–	–	–	–	–
Age			24.730	2	.000*			
15-19	.334	.169	3.918	1	.048*	1.397	1.003	1.944

20-34	.428	.086	24.651	1	.000*	1.535	1.296	1.818
35-49 (rc)	–	–	–	–	–	–	–	–
Number of living children			70.496	2	.000*			
0	-1.364	.162	70.443	1	.000*	.256	.186	.352
1-4	-.397	.090	19.625	1	.000*	.672	.564	.802
5 and more	–	–	–	–	–	–	–	–
Heard FP on radio (No)	-.497	.080	38.364	1	.000*	.608	.520	.712
Yes (rc)	–	–	–	–	–	–	–	–
Visited by FP worker (No)	-.289	.113	6.505	1	.011*	.749	.600	.935
Yes (rc)	–	–	–	–	–	–	–	–
Constant	1.122	.238	22.132	1	.000*	3.070		

rc-reference category

* Significant ($p<0.05$)

From the last column of Table 3, the estimate for age of woman indicate that the odds of contraceptive use women in the middle age group is 1.535 times higher than the oldest age group. Younger age groups are more likely to use contraceptive than older age group, other factors held constant. Hence, women in the middle age group are more likely to accept contraceptive methods to regulate or terminate fertility than the older women.

Contraceptive use is at its lowest when women in the early reproductive ages. Women who have no children and who have 1 to 4 children are less likely to use contraceptive than those who have children 5 and more.

A woman's level of education is a very important predictor of contraceptive use showing an increase in contraceptive use as educational level increases. Those whose level of education is below primary are less likely to use contraceptives than those with above primary education. The findings of positive association between women's education and contraceptive use were in line with one's expectation. Education increases knowledge about contraceptive methods, family planning outlets and brings about favorable attitudinal changes towards contraceptive use. Less educated women have less exposure to modern ideas and family planning information, and, thus, are less likely to accept the idea of small family size than educated women. Similarly, using the odds of contraceptive use among women whose partners having secondary and higher level of education as a reference, women whose partners had no education have the least chance to use contraceptive.

One of the important findings which was obtained from the logistic regression analysis was that, partner's occupation had statistically significant impact on contraceptive use. Women whose partners are engaged in agriculture were found to have lower use of contraceptive than women whose partners involved in non-agriculture followed by those whose partners did not work. This result highlights the relevance of partner's socioeconomic background as equally an important variable as that of the wives in explaining some of the variation in contraceptive use among married women.

As indicated in Table 3, women's religious affiliation was found to be related to their contraceptive behavior. Pattern of contraceptive use for women affiliated with protestant, Muslim and Other religion is found lower as compared to those belonging to the Orthodox Christian.

Place of residence also significantly affects the chance of using contraceptives. According to the multiple logistic regression results, the odds of using contraceptives for individuals in the urban area is found to be 1.717 times larger than that of the rural area.

Visiting a health facility is also an important variable affecting contraceptive use. Women who visited a health facility in the last 12 months before the survey have a better chance to know about contraceptives. Indeed, the odds of using contraceptives of a woman who did not visit a health facility in the last 12 months before the survey was found to be 0.506 times (almost half as much) to use contraceptives than a woman who visited a health facility.

The results also suggest that women who were visited by a family planning worker have a better chance of fulfilling their contraceptive needs as compared to those who were not visited by family planning worker. The odds of using contraceptives is lower for women who were not visited by family planning worker than women who were visited by family planning worker in the last 12 months before the survey.

Exposure to family planning messages on radio has also been found to strengthen women's motivation to prevent unwanted fertility. The odds of using contraceptives for women who did not hear family planning messages on radio are less likely to use contraceptives than those women who were exposed to the messages on this media in the last 12 months before the survey.

Employment status significantly affects the chance of using contraceptives. The result in Table 3 shows, the odds of using contraceptives for unemployed is 0.758 times the odds of using contraceptive for employed women.

Finally, the results suggest that women who live in Somali region have less chance of using contraceptive than those from Addis Ababa followed by Afar, Tigray, SNNP and Oromiya.

Table 4: Classification Table

Observed		Predicted		
		Pattern of use		Percentage Correct
		currently not using	currently using	
Pattern of use	currently not using	6603	304	95.6
	currently using	914	518	36.2
Overall Percentage				85.4

The cut value is .500

In logistic regression analysis with a dichotomous dependent variable the classification tables are given by 2 x 2 table in Table 4. The columns give the two predicted outcomes of the dependent variable, while the rows are the two observed (actual) outcomes of the dependent variable. In a perfect model, it is supposed that all cases will be on the diagonal and the overall percent will be 100 percent. Our model shows a good percentage of correct predictions (85.4 %) for the contraceptive use of Ethiopian married women.

4.3 Test of Goodness of fit of the logistic model

The hypothesis to be tested here is:

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

The SPSS output of the Hosmer-Lemeshow test for our final model is given in Tables 5 and 6.

Table 5: Contingency table for Hosmer-Lemeshow test

	Pattern of use=0 currently not using		Pattern of use=1 Currently using		Total
	Observed	Expected	Observed	Expected	
1	831	823.312	3	10.688	834
2	807	806.452	29	29.548	836
3	787	775.296	31	42.704	818
4	786	778.706	49	56.294	835
5	759	763.629	75	70.371	834
6	741	747.849	97	90.151	838
7	701	719.449	137	118.551	838
8	656	664.114	178	169.886	834
9	530	530.515	304	303.485	834
10	309	297.676	529	540.324	838

The test using the observed and expected values above is given in Table 6.

Table 6: Hosmer and Lemeshow Test

Chi-square	df	Sig.
15.426	8	.051*

* Significant ($p<0.05$)

Table 6 presents Hosmer-Lemeshow's goodness of fit test result for the fitted logistic regression model. As it can be seen from the table, the model gave a Chi-square value of 15.426 with 8 degrees of freedom having a p-value 0.051 which is greater than 0.05. Therefore, we do not reject the null hypothesis and conclude 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..

4.4 Multilevel logistic regression analysis

4.4.1 Test of heterogeneity of proportions

In testing heterogeneity of proportions, as discussed in section 3.2.2.4, we obtained a calculated value for the Commenges and Jacqmin test statistic T_{cal} = 6473.65 ($p<0.05$). This is an indication of the presence of heterogeneous proportions, that is, there is a significant variation with respect to use of contraceptives for married women among the regions.

4.4.2 Two level empty logistic regression analysis

Fitting the empty model to the data of pattern of contraceptive use yields the parameter estimates presented in Table 7. The deviance in this table is given for the sake of completeness and later reference.

Table 7: Estimates for empty model

Fixed part	Coefficient	Standard error	P-value
Intercept	1.7182	0.0307	0.0000*
Random part	Variance component	Standard error	P-value

Level two variance			
Var (U_{0j})	1.1870	0.3695	0.0013*
Deviance	6868.4364		

*Significant ($p<0.05$)

The intercept and variance component are found to be significant. The significant random part indicates that use of contraception varies among the regions.

Table 8 displays the difference in the deviance between an empty model without random effect (deviance = 7648.6662, see Appendix) and an empty model with random effect (deviance = 6868.4364).

Table 8: Deviance-based Chi-Square test for significance of random effects

Chi-Square	df	p-value
780.2298	1	0.0000*

* Significant ($p<0.05$)

The significance of the Chi-Square value, 780.2298, listed in Table 8 implies that an empty model with random intercept is better than an empty model without random intercept.

Next, we present the results obtained by using a random intercept and fixed slopes multilevel logistic regression analysis for selected explanatory variables. Since we used the student version of the software, LISREL, the number of explanatory variables and their categories to be included in the analysis were restricted. As a result we have used two blocks of variables. The first block includes "education", "visited health facility", "employment status", "heard FP on radio" and "visited by FP worker". The second block includes "religion", "number of living children" and "age".

4.4.3 Two level random intercept logistic regression analysis

The results of two level random intercept logistic regression analysis for the first and second block of variables are presented in Tables 9 and 10, respectively.

Table 9: Estimates for Random Intercept and Fixed Slopes for current use of contraception (Block 1)

Fixed part	Coefficient	Standard error	P-value
Intercept	2.5973	0.0547	0.0000*
Education (primary or illiterate)	-1.0773	0.0838	0.0000*
above primary (rc)	–	–	–
Visited Health facility (No)	-0.7843	0.0670	0.0000*
Yes (rc)	–	–	–
Employment status (unemployed)	-0.3347	0.0700	0.0000*
Employed (rc)	–	–	–
Heard FP on radio (No)	-0.8048	0.0712	0.0000*
Yes (rc)	–	–	–
Visited by FP worker (No)	-0.2981	0.1082	0.0059*
Yes (rc)	–	–	–

Random part	Variance component	Standard error .	P-value
Level two variance			
Var (U_{0j})	0.5074	0.1598	0.0015*
Deviance	6188.1555		

* Significant (p<0.05)

Table 10: Estimates for Random Intercept and Fixed Slopes for current use of contraception (Block 2)

Fixed part	Coefficient	Standard error	P-value
Intercept	3.5897	0.1918	0.0000*
Religion (Others)	-0.9569	0.0633	0.0000*
Orthodox (rc)	_	_	_
Age (15-19)	0.0548	0.1473	0.7100
20-34	0.4241	0.0684	0.0000*
35-49 (rc)	_	_	_
Number of living children(0)	-0.7807	0.1311	0.0000*
1^+ (rc)	_	_	_
Random part	**Variance component**	**Standard error**	**P-value**
Level two variance			
Var (U_{0j})	0.9714	0.3012	0.0013*
Deviance	6623.0836		

* Significant (p<0.05)

Tables 9 and 10 revealed that there exist variations in the mean effect of current contraceptive use among married women in Ethiopia at region level.

The variance component representing variation between regions, however, has diminished markedly from 1.1870 (see Table 7) in the empty model to 0.5074 (see Table 9) in the random intercept and fixed slopes multilevel logistic regression model for block 1 and from 1.1870 in the empty model to 0.9714 (see Table 10) in the random intercept and fixed slopes multilevel logistic regression model for block 2. These tell us that the listed predictors explain a large portion of the region-to-region variation in mean contraceptive use.

Tables 11 and 12 show the differences in the deviances between a random intercept with fixed effects of the first and second block of variables (deviances 6188.1555 and 6623.0836, respectively) and a model without a random intercept with the fixed effects of the same set of first and second block variables (deviances 6404.9883 and 7302.2130, see Appendix B and D), respectively.

Table 11: Deviance-based Chi-Square test for significance of random effects (Block 1)

Chi-Square	df	p-value
216.8328	1	0.0000*

* Significant ($p<0.05$)

Table 12: Deviance-based Chi-Square test for significance of random effects (Block 2)

Chi-Square	df	p-value
679.1294	1	0.0000*

* Significant ($p<0.05$)

The significance of the Chi-Square (deviance differences) values, 216.8328 in Table 11 and 679.1294 in Table 12 imply that a model with random intercept and fixed slopes is good to see the region-to-region variation in mean contraceptive use than a model without a random intercept with the same fixed slopes.

4.4.4 Two level random coefficient logistic regression analysis

As a next step, it was investigated whether extra random effects give an improvement of the model fit. Recall that a random effect for a variable X means that the effect of X on Y varies between regions. In Tables 13 and 14 we present the results of random coefficient multilevel logistic regression analysis for block 1 and block 2 explanatory variables, respectively.

Table 13: Estimates for random Coefficient model (Block 1)

Fixed part	Coefficient	Standard error	P-value
Intercept	2.6859	0.0557	0.0000*
Education (primary or illiterate)	-1.1826	0.0831	0.0000*
above primary (rc)	_	_	_
Visited Health facility (No)	-0.7859	0.0670	0.0000*
Yes (rc)	_	_	_
Employment status (Unemployed)	-0.3781	0.0696	0.0000*
Employed (rc)	_	_	_
Heard FP on radio (No)	-0.9943	0.0713	0.0000*
Yes (rc)	_	_	_
Visited by FP worker (No)	- 0.2074	0.1093	0.0577
Yes (rc)	_	_	_

Random part	Variance component	Standard error	P-value
Level two variance			
Var (U_{0j})	1.2047	0.3812	0.0016*
Var (U_{1j})	0.0976	0.0345	0.0046*
Var (U_{2j})	0.0548	0.0223	0.0142*

Var (U_{3j})	0.0873	0.0331	0.0083*
Var (U_{4j})	0.3387	0.1116	0.0024*
Var (U_{5j})	0.1678	0.0634	0.0081*
Cov (U_{0j}, U_{1j})	-0.2895	0.1025	0.0047*
Cov (U_{0j}, U_{2j})	-0.1343	0.0705	0.0566
Cov (U_{0j}, U_{3j})	-0.2185	0.0926	0.0183*
Cov (U_{0j}, U_{4j})	-0.5751	0.1948	0.0032*
Cov (U_{0j}, U_{5j})	0.2846	0.1253	0.0232*
Cov (U_{1j}, U_{2j})	0.0296	0.0205	0.1485
Cov (U_{1j}, U_{3j})	0.0205	0.0243	0.3988
Cov (U_{1j}, U_{4j})	0.1590	0.0563	0.0047*
Cov (U_{1j}, U_{5j})	-0.0810	0.0377	0.0311*
Cov (U_{2j}, U_{3j})	0.0206	0.0198	0.2992
Cov (U_{2j}, U_{4j})	0.0683	0.0379	0.0714
Cov (U_{2j}, U_{5j})	-0.0866	0.0353	0.0142*
Cov (U_{3j}, U_{4j})	0.0797	0.0465	0.0866
Cov (U_{3j}, U_{5j})	-0.0289	0.0330	0.3820
Cov (U_{4j}, U_{5j})	-0.1738	0.0708	0.0141*
Deviance	6076.5644		

* Significant ($p<0.05$)

Table 14: Estimates for random Coefficient model (Block 2)

Fixed part	Coefficient	Standard error	P-value
Intercept	3.7087	0.1928	0.0000*
Religion (Others)	-1.3010	0.0643	0.0000*
Orthodox (rc)	_	_	_
Age (15-19)	0.2073	0.1482	0.1620
20-34	0.4812	0.0687	0.0000*
35-49 (rc)	_	_	_
NOLIVCH(0)	-0.8240	0.1336	0.0000*
1^+ (rc)	_	_	_

Random part	Variance component	Standard error	P-value
Level two variance			
Var (U_{0j})	4.2534	1.3793	0.0020*
Var (U_{1j})	1.7797	0.5699	0.0018*
Var (U_{2j})	0.1306	0.0497	0.0086*
Var (U_{3j})	0.1838	0.0877	0.0361*
Var (U_{4j})	0.0944	0.0308	0.0022*
Cov (U_{0j}, U_{1j})	-2.4698	0.8421	0.0034*
Cov (U_{0j}, U_{2j})	0.6716	0.2366	0.0045*
Cov(U_{0j},U_{3j})	0.0368	0.2332	0.8747
Cov (U_{0j}, U_{4j})	-0.1665	0.1498	0.2663
Cov (U_{1j}, U_{2j})	-0.3837	0.1451	0.0082*
Cov (U_{1j}, U_{3j})	-0.1566	0.1539	0.3088
Cov (U_{1j}, U_{4j})	-0.0720	0.0946	0.4470
Cov (U_{2j}, U_{3j})	-0.0169	0.0467	0.7178
Cov (U_{2j}, U_{4j})	-0.0354	0.0287	0.2171
Cov (U_{3j}, U_{4j})	0.0509	0.0384	0.1851

Deviance	6454.0706

* Significant ($p<0.05$)

Table 15: Correlation Matrix of Random components (Block 1)

	Intercept	WOMEDU	VHEFAC	EMPLOY	HFPRADIO	VFPWORK
Intercept	1.000000					
WOMEDU	-0.844036	1.000000				
VHEFAC	-0.522938	0.405237	1.000000			
EMPLOY	-0.673516	0.221817	0.297929	1.000000		
HFPRADIO	-0.900461	0.874204	0.501789	0.463423	1.000000	
VFPWORK	0.633045	-0.633132	-0.903538	-0.238555	-0.729228	1.000000

Table 16: Correlation Matrix of Random components (Block 2)

	Intercept	Religion	Age (15-19)	Age (20-34)	NOLIVCH
Intercept	1.000000				
Religion	-0.897680	1.000000			
Age (15-19)	0.041576	-0.273880	1.000000		
Age(20-34)	-0.262735	-0.175538	0.386662	1.000000	
NOLIVCH	0.901106	-0.796028	-0.108895	-0.318950	1.000000

The multilevel multivariate analysis using the first block variables in Table 13 shows that the listed explanatory variables except VFPWORK significantly contribute to the use of contraceptives.

In Table 13, the value Var (U0j) = 1.2047 is the estimated intercept variance; the values of Var (U_{1j}), Var (U_{2j}), Var (U_{3j}), Var (U_{4j}) and Var (U_{5j}) are the estimated variances of slopes for "education", "visited health facility", "employment status', "heard family planning on radio" and "visited by family planning worker". 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. Many of the covariances of the interaction terms between intercepts and slopes of explanatory variables are also found to be significant. Interpretation of significant covariance terms can be easily made in terms of the correlation coefficients displayed in Tables 15 and 16. 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. For example, the correlation between the intercept and random slope on VFPWORK is 0.633, which means that, married women who were visited by family planning worker tend to use contraceptive more frequently than those who were not visited by family planning worker by a larger factor at regions with higher intercepts compared to regions with lower intercepts. This implies that married women in Somali region who were visited by family planning worker are more likely to use contraceptive than those married women in other regions.

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. In the same sense, regions with lower intercepts tend to have on average higher slopes. That is, married women in Addis Ababa whose educational level is above primary level, who are employed and who have heard family planning on radio are more likely to use contraceptive than those married women in other regions. While married women in Tigray who visited health facility are more likely to use contraceptives than those in other regions. Similarly one can interpret the regional variations based on the second block variables.

Tables 17 and 18 display the difference in the deviance between random coefficient model for the first and second block variables (deviances 6076.5644 and 6454.0706, respectively) and fixed coefficient model for the same set of first and second block variables (deviances 6404.9883 and 7302.2130, see Appendix Band D), respectively.

Table 17: Deviance-based Chi-Square test for significance of random effects (Block 1)

Chi-Square	df	p-value
328.4239	21	0.0000*

* Significant ($p<0.05$)

Table 18: Deviance-based Chi-Square test for significance of random effects (Block 2)

Chi-Square	df	p-value
848.1424	15	0.0000*

* Significant ($p<0.05$)

The significance of the Chi-Square (deviance differences) values, 328.4239, in Table 17 and 848.1424, in Table 18 indicate that a model with random coefficient is more suitable to explain the regional variation than a model with fixed coefficients.

The statistical significance of the improvement in fit due to the inclusion of extra parameters in the random part of the model can be tested as follows. Suppose a model

M_0 has been estimated with N parameters (variances and covariances) for the random effects and certain fixed effects. Now a second model M_1 is estimated with N + k parameters for the random effects, and the same set of fixed effects as model M_0. The null hypothesis is that model M_0 is valid, that is, the additional parameters for random effects in model M_1 are zero. Denote the deviance of model M_0 by D_0 and the deviance of model M_1 by D_1. Under the null hypothesis that model M_0 holds, the difference D_0-D_1 has (approximately, for large sample sizes) a Chi-Square distribution with k df. For instance, suppose random intercept model, M_0, has five fixed coefficients, one variance parameter, and a deviance of 6188.1555. Suppose the random coefficient model, M_1, has five variance and 15 extra covariance parameters and a deviance of 6076.5644. This results in model M_1 having 20 parameters (more than model M_0) while the difference in deviance is 111.5911. Testing this difference in the Chi-Square distribution with 20 degrees of freedom shows that it is a significant value. That is, a random coefficient model is better to explain the regional variation than a random intercept with fixed slopes model.

The above results, imply that all the predictors are not equally and effectively defining the characteristics of married women in all the regions. This signifies that further investigation is required in tracking those regions which have lower mean effects and thus identifying the factors that have contributions to increase the contraceptive use of currently married women in each region. Region-wise estimates are presented in Tables 19 and 20.

Table 19: Estimates for random Coefficient model by region (Block 1)

		Variables					
Regions		**Intercepts**	**Education**	**VHEFAC**	**EMPLOY**	**HFPRADIO**	**VFPWORK**
Tigray	Estimate	-0.241991	0.028226	0.314282	0.055415	0.332156	-0.537480
	Std.er.	0.020137	0.01366	0.017885	0.023622	0.027372	0.036506
	Z-value	-12.01687*	2.065274*	17.572379*	2.345906*	12.134882*	-14.72305*
Afar	Estimate	1.423255	-0.406892	0.009073	-0.212757	-0.726358	0.142262
	Std.er.	0.084170	0.027860	0.033119	0.039943	0.067010	0.080503
	Z-value	16.909290*	-14.60488*	0.273952	-5.326515*	-10.83954*	1.767157
Amhara	Estimate	-0.157005	0.219055	-0.122550	-0.216049	0.249291	0.058613
	Std.er.	0.013166	0.010678	0.013477	0.018000	0.020207	0.027665
	Z-value	-11.92503*	20.514609*	-9.093270*	-12.00272*	12.336863*	2.118669*
Oromiya	Estimate	0.260244	-0.152445	-0.237559	0.130894	-0.115798	0.371737
	Std.er.	0.018135	0.010487	0.013890	0.017357	0.019814	0.029841
	Z-value	14.350372*	-14.53656*	-17.10287*	7.541280*	-5.844251*	12.457256*
Somali	Estimate	2.241043	-0.571508	-0.250062	-0.351819	-1.105978	0.552059
	Std.er.	0.206392	0.03800	0.041076	0.050388	0.108003	0.106671
	Z-value	10.858187*	-15.03758*	-6.087753*	-6.982198*	-10.24018*	5.175351*
Ben-Gumz	Estimate	0.027599	-0.100887	-0.107905	0.167787	-0.124522	0.222498
	Std.er.	0.032656	0.015631	0.023319	0.028991	0.036854	0.050972
	Z-value	0.845149	-6.454163*	-4.627272*	5.787415*	-3.378735*	4.365070*
SNNP	Estimate	-0.052015	0.242858	0.001549	-0.259826	0.443824	-0.251093

	Std.er.	0.012197	0.0114090	0.013244	0.019287	0.022357	0.025744
	Z-value	-4.264324*	21.286528*	0.117015	-13.47136*	19.851178*	-9.753355*
Gambela	Estimate	-0.677848	0.277999	0.165814	-0.035987	0.314759	-0.320160
	Std.er.	0.021658	0.016144	0.026725	0.027698	0.040768	0.060042
	Z-value	-31.29740*	17.219016*	6.204313*	-1.299233	7.720678*	-5.332247*
Harari	Estimate	0.073154	-0.025604	-0.031472	-0.064990	-0.343129	0.184375
	Std.er.	0.061993	0.015297	0.020205	0.023707	0.043240	0.045982
	Z-value	1.180042	-1.973829*	-1.557603	-2.741383*	-7.935366*	4.009743*
AddisAbaba	Estimate	-2.096422	0.411873	0.293814	0.497548	0.948058	-0.532654
	Std.er.	0.038292	0.013184	0.016892	0.018987	0.026279	0.033968
	Z-value	-54.74774*	31.24015*	17.392901*	26.204268*	36.095746*	-15.68073*
Dire Dawa	Estimate	-0.800013	0.077327	-0.034985	0.289785	0.127696	0.109840
	Std.er.	0.040250	0.014785	0.022194	0.024010	0.032274	0.047440
	Z-value	-19.87580*	1.921151	-1.576328	12.069178*	3.956579*	2.315345*

* Significant ($p<0.05$)

Table 20: Estimates for random Coefficient model by region (Block 2)

Regions		Intercepts	Religion	NOLIVCH	Age(15-19)	Age(20-34)
Tigray	Estimate	-0.978048	1.366947	-0.130222	-0.511022	-0.32491
	Std.er.	0.902055	0.280592	0.040759	0.102733	0.006206
	Z value	-1.084244	4.8716535*	-3.194926*	-4.97427*	-52.3541*
Afar	Estimate	1.947536	-1.008296	0.277627	0.170205	-0.153503
	Std.er.	0.287359	0.17291	0.028338	0.132259	0.015754
	Z value	6.777362*	-5.83133*	9.7969863*	1.286906	-9.74374*
Amhara	Estimate	-1.244875	1.321277	-0.081079	-0.261189	-0.279322
	Std.er.	0.173119	0.042241	0.022646	0.072196	0.003968
	Z value	-7.190862*	31.279491*	-3.5802790*	-3.61777*	-70.3936*
Oromiya	Estimate	-0.019665	0.516911	-0.0277	-0.289233	-0.218936
	Std.er.	0.094274	0.024316	0.02014	0.075919	0.004346
	Z value	-0.2085941	21.258060*	-1.3753723	-3.80975*	-50.3764*
Somali	Estimate	4.798779	-3.058473	0.777226	0.162459	-0.066958
	Std.er.	0.785767	0.506135	0.042884	0.168453	0.034157
	Z value	6.1071271*	-6.042800*	18.1239156*	0.964417*	-1.96030*
Ben-Gumz	Estimate	-0.87362	0.788774	-0.177207	0.461799	-0.18769
	Std.er.	0.145777	0.057312	0.023827	0.090321	0.006068
	Z value	-5.9928521*	13.7628070*	-7.4372350*	5.1128641*	-30.93111*
SNNP	Estimate	-0.178493	0.526065	-0.044163	-0.103152	-0.197219
	Std.er.	0.111705	0.030009	0.021812	0.094992	0.005224
	Z value	-1.5978962	17.530240*	-2.02471117*	-1.085902	-37.75248*
Gambela	Estimate	0.62936	-0.630072	0.090818	0.089631	0.113324

	Std.er.	0.180052	0.060129	0.023564	0.11113	0.006627
	Z value	3.49543465*	-10.478670*	3.85409947*	0.8065419	17.100347*
Harari	Estimate	0.123105	-0.747199	0.094539	-0.146796	0.350296
	Std.er.	0.127279	0.05325	0.020483	0.093251	0.007039
	Z value	0.96720590	-14.031906*	4.61548601*	-1.574203	49.765023*
AddisAbaba	Estimate	-3.559513	1.387496	-0.59826	0.060382	0.510725
	Std.er.	0.215711	0.051216	0.023556	0.116953	0.006175
	Z value	-16.501305*	27.0910652*	-25.397351*	0.5162929	82.708502*
Dire Dawa	Estimate	-0.644565	-0.463431	-0.181578	0.366916	0.454194
	Std.er.	0.144972	0.051613	0.021499	0.103706	0.00693
	Z value	-4.4461344*	-8.9789587*	-8.4458812*	3.5380402*	65.54026*

* Significant ($p<0.05$)

Detail outputs of the multilevel logistic regression are included in the Appendix.

Table 19 shows that, for example, all first block variables are significant in Tigray region and except NOLIVCH all first block variables are significant in Oromiya region. And this shows the presence of variation among regions. We can interpret the other explanatory variables in a similar way.

Chapter Five

Conclusion and Recommendations

This study has shown that the decision to use contraception is determined by a number of socio-demographic characteristics of women and regional differences. Only 17.2 percent of currently married women use contraception methods. This low level of use of contraception may have serious implications for controlling the fertility in Ethiopia.

At the individual level, older women are observed to have particularly low contraceptive usage as compared with those with the middle age group. In addition, a relationship has been observed between contraceptive use and education. Women with lower than primary level of education are less likely to use contraceptive use than those with more than primary education. Thus, women education needs special attention for the promotion of family planning services. The partner's education and work status is also important; women whose partners have no education and are not working are less likely to use contraceptives. Reaching people with information about family planning through communication campaigns like radio can create awareness of family planning and promote information about contraceptive use. Women who were visited by family planning workers have a better chance of fulfilling their contraceptive needs as compared to those who were not visited. A woman who visited a health facility has a better chance of satisfying her demand for contraceptives.

The multilevel multivariate analysis also confirms the findings of the logistic regression. That is, the mean effect of the predictors such as "education of woman", "visited health facility", "employment status", "heard family planning on radio", "visited by family planning worker", "religion", "age" and "number of living children" on contraceptive use varied considerably among regions. The study revealed that different regions have significantly different mean effects, which had remained unknown in the studies with the single level modeling approach done so far.

To achieve a further increase in the contraceptive prevalence rate, it is now worthwhile to create a greater awareness among women about the issues that are found to affect contraceptive prevalence significantly. Thus awareness programs should encourage women that they should visit health facilities, practice to hear family planning on radio and also use the advise of family planning workers on the use of contraception and on how to use different methods.

In addition to the above, it is also worthwhile to address specific messages to those regions in which the mean effects of the respective factors are significantly lower than in other regions. It is necessary to find out the reasons why they are not significant. Thus besides widening the running of family planning program facilities along with the present awareness program to all the regions, it is beneficial to give special attention to those regions where the program efforts remained less effective and to extend facilities to target regions with the specific goal of further increasing contraceptive prevalence.

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OUTPUT FOR MULTILEVEL LOGISTIC REGRESSION

Appendix A: EMPTY MODEL

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| Results for the model without any random effects |

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Goodness of fit statistics

Statistic	Value	DF	Ratio
---------	-----	--	-----
Likelihood Ratio Chi-square	7648.6662	8338	0.9173
Pearson Chi-square	8339.0000	8338	1.0001
Deviance	7648.6662		
Akaike Information Criterion	7650.6662		
Schwarz Criterion	7657.6949		

Estimated regression weights

Parameter	Estimate	Standard Error	z Value	P Value
---------	--------	--------	-------	-------
INTERCEPT	1.5735	0.0290	54.1896	0.0000

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| Results for the model with fixed and random effects |

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Goodness of fit statistics

Statistic	Value	DF	Ratio
---------	-----	--	-----
Likelihood Ratio Chi-square	6868.4363	8337	0.8238
Pearson Chi-square	8213.3510	8337	0.9852
Deviance	6868.4364		
Akaike Information Criterion	6870.4364		
Schwarz Criterion	6877.4651		

Estimated regression weights

Parameter	Estimate	Standard Error	z Value	P Value
---------	--------	--------	-------	-------
INTERCEPT	1.7182	0.0307	56.0557	0.0000

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

NDF	Chi-Square	P Value
1	780.2298	0.0000

Estimated level 2 variances and covariances

Parameter	Estimate	Standard Error	z Value	P Value
intcept/intcept	1.1870	0.3695	3.2122	0.0013

Level 2 covariance matrix

	intcept
intcept	1.186952

Level 2 correlation matrix

	intcept
intcept	1.000000

Appendix B: RANDOM INTERCEPT AND FIXED SLOPES.........FOR THE FIRST BLOCK VARIABLES

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results for the model without any random effects |

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Goodness of fit statistics

Statistic	Value	DF	Ratio
Likelihood Ratio Chi-square	6404.9883	8333	0.7686
Pearson Chi-square	8121.4721	8333	0.9746
Deviance	6404.9883		
Akaike Information Criterion	6416.9883		
Schwarz Criterion	6459.1605		

Estimated regression weights

Parameter	Estimate	Standard Error	z Value	P Value
intcept	2.6358	0.0540	48.7993	0.0000
WOMEDU	-1.3613	0.0823	-16.5469	0.0000
VHEFAC	-0.8403	0.0659	-12.7563	0.0000
EMPLOY	-0.4212	0.0692	-6.0860	0.0000
HFPRADIO	-0.9313	0.0703	-13.2432	0.0000
VFPWORK	-0.2691	0.1080	-2.4910	0.0127

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| Results for the model with fixed and random effects |

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Goodness of fit statistics

Statistic	Value	DF	Ratio
Likelihood Ratio Chi-square	6188.1550	8332	0.7427
Pearson Chi-square	7716.8301	8332	0.9262
Deviance	6188.1555		
Akaike Information Criterion	6200.1555		
Schwarz Criterion	6242.3277		

Estimated regression weights

Parameter	Estimate	Standard Error	z Value	P Value
intcept	2.5973	0.0547	47.4440	0.0000
WOMEDU	-1.0773	0.0838	-12.8565	0.0000
VHEFAC	-0.7843	0.0670	-11.7111	0.0000
EMPLOY	-0.3347	0.0700	-4.7786	0.0000
HFPRADIO	-0.8048	0.0712	-11.2993	0.0000
VFPWORK	-0.2981	0.1082	-2.7548	0.0059

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

NDF	Chi-Square	P Value
1	216.8328	0.0000

Estimated level 2 variances and covariances

Parameter	Estimate	Standard Error	z Value	P Value
---------	--------	--------	-------	-------
intcept/intcept	0.5074	0.1598	3.1743	0.0

Level 2 covariance matrix

	intcept
intcept	0.507351

Level 2 correlation matrix

	intcept
intcept	1.000000

Appendix C: RANDOM COEFFICIENT.......... FOR THE FIRST BLOCK VARIABLES

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| **Results for the model without any random effects** |

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Goodness of fit statistics

Statistic	Value	DF	Ratio
---------	-----	--	-----
Likelihood Ratio Chi-square	6404.9883	8333	0.7686
Pearson Chi-square	8121.4721	8333	0.9746
Deviance	6404.9883		
Akaike Information Criterion	6416.9883		
Schwarz Criterion	6459.1605		

Estimated regression weights

Parameter	Estimate	Standard Error	z Value	P Value
---------	--------	--------	-------	-------
intcept	2.6358	0.0540	48.7993	0.0000
WOMEDU	-1.3613	0.0823	-16.5469	0.0000
VHEFAC	-0.8403	0.0659	-12.7563	0.0000
EMPLOY	-0.4212	0.0692	-6.0860	0.0000

HFPRADIO	-0.9313	0.0703	-13.2432	0.0000
VFPWORK	-0.2691	0.1080	-2.4910	0.0127

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| **Results for the model with fixed and random effects** |

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Goodness of fit statistics

Statistic	Value	DF	Ratio
---------	-----	--	-----
Likelihood Ratio Chi-square	6076.5867	8327	0.7297
Pearson Chi-square	7696.5056	8327	0.9243
Deviance	6076.5644		
Akaike Information Criterion	6088.5644		
Schwarz Criterion	6130.7366		

Estimated regression weights

Parameter	Estimate	Standard Error	z Value	P Value
---------	--------	--------	-------	-------
intcept	2.6859	0.0557	48.2387	0.0000
WOMEDU	-1.1826	0.0831	-14.2240	0.0000
VHEFAC	-0.7859	0.0670	-11.7271	0.0000
EMPLOY	-0.3781	0.0696	-5.4298	0.0000
HFPRADIO	-0.9943	0.0713	-13.9383	0.0000
VFPWORK	-0.2074	0.1093	-1.8982	0.0577

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

NDF	Chi-Square	P Value
---	----------	-------
21	328.4239	0.0000

Estimated level 2 variances and covariances

Parameter	Estimate	Standard Error	z Value	P Value
---------	--------	--------	-------	-------
intcept/intcept	1.2047	0.3812	3.1600	0.0016
WOMEDU/intcept	-0.2895	0.1025	-2.8255	0.0047
WOMEDU/WOMEDU	0.0976	0.0345	2.8316	0.0046
VHEFAC/intcept	-0.1343	0.0705	-1.9066	0.0566

VHEFAC/WOMEDU	0.0296	0.0205	1.4449	0.1485
VHEFAC/VHEFAC	0.0548	0.0223	2.4512	0.0142
EMPLOY/intcept	-0.2185	0.0926	-2.3587	0.0183
EMPLOY/WOMEDU	0.0205	0.0243	0.8438	0.3988
EMPLOY/VHEFAC	0.0206	0.0198	1.0382	0.2992
EMPLOY/EMPLOY	0.0873	0.0331	2.6415	0.0083
HFPRADIO/intcept	-0.5751	0.1948	-2.9518	0.0032
HFPRADIO/WOMEDU	0.1590	0.0563	2.8253	0.0047
HFPRADIO/VHEFAC	0.0683	0.0379	1.8028	0.0714
HFPRADIO/EMPLOY	0.0797	0.0465	1.7138	0.0866
HFPRADIO/HFPRADIO	0.3387	0.1116	3.0348	0.0024
VFPWORK/intcept	0.2846	0.1253	2.2705	0.0232
VFPWORK/WOMEDU	-0.0810	0.0377	-2.1481	0.0317
VFPWORK/VHEFAC	-0.0866	0.0353	-2.4520	0.0142
VFPWORK/EMPLOY	-0.0289	0.0330	-0.8742	0.3820
VFPWORK/HFPRADIO	-0.1738	0.0708	-2.4539	0.0141
VFPWORK/VFPWORK	0.1678	0.0634	2.6476	0.0081

Level 2 covariance matrix

	intcept	WOMEDU	VHEFAC	EMPLOY	HFPRADIO	VFPWORK
intcept	1.204657					
WOMEDU	-0.289476	0.097643				
VHEFAC	-0.134333	0.029637	0.054778			
EMPLOY	-0.218455	0.020483	0.020606	0.087330		
HFPRADIO	-0.575147	0.158970	0.068345	0.079697	0.338661	
VFPWORK	0.284609	-0.081040	-0.086623	-0.028877	-0.173832	0.167790

Level 2 correlation matrix

	intcept	WOMEDU	VHEFAC	EMPLOY	HFPRADIO	VFPWORK
intcept	1.000000					
WOMEDU	-0.844036	1.000000				
VHEFAC	-0.522938	0.405237	1.000000			
EMPLOY	-0.673516	0.221817	0.297929	1.000000		
HFPRADIO	-0.900461	0.874204	0.501789	0.463423	1.000000	
VFPWORK	0.633045	-0.633132	-0.903538	-0.238555	-0.729228	1.000000

Appendix D: RANDOM INTERCEPT AND FIXED SLOPES.........FOR THE SECOND BLOCK VARIABLES

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Results for the model without any random effects |

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Goodness of fit statistics

Statistic	Value	DF	Ratio
---------	-----	--	-----
Likelihood Ratio Chi-square	7302.2130	8334	0.8762
Pearson Chi-square	8347.9667	8334	1.0017
Deviance	7302.2130		
Akaike Information Criterion	7312.2130		
Schwarz Criterion	7347.3565		

Estimated regression weights

Parameter	Estimate	Standard Error	z Value	P Value
---------	--------	--------	-------	-------
intcept	3.6217	0.1838	19.7023	0.0000
RELIG	-1.0005	0.0603	-16.5870	0.0000
NOLIVCHC	-0.5581	0.1269	-4.3963	0.0000
AGE(15-19)	-0.1736	0.1456	-1.1923	0.2332
AGE(15-19)	0.3294	0.0646	5.0997	0.0000

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Results for the model with fixed and random effects |

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Goodness of fit statistics

Statistic	Value	DF	Ratio
---------	-----	--	-----
Likelihood Ratio Chi-square	6623.0834	8333	0.7948
Pearson Chi-square	8319.2525	8333	0.9984
Deviance	6623.0836		
Akaike Information Criterion	6633.0836		
Schwarz Criterion	6668.2271		

Estimated regression weights

Parameter	Estimate	Standard Error	z Value	P Value
---------	--------	--------	-------	-------
intcept	3.5897	0.1918	18.7160	0.0000
RELIG	-0.9569	0.0633	-15.1155	0.0000

NOLIVCHC	-0.7807	0.1311	-5.9542	0.0000
AGE(15-19)	0.0548	0.1473	0.3719	0.7100
AGE(20-34)	0.4241	0.0684	6.2007	0.0000

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

NDF	Chi-Square	P Value
1	679.1294	0.0000

Estimated level 2 variances and covariances

Parameter	Estimate	Standard Error	z Value	P Value
intcept/intcept	0.9714	0.3012	3.2253	0.0013

Level 2 covariance matrix

	intcept
intcept	0.971431

Level 2 correlation matrix

	intcept
intcept	1.000000

Appendix E: RANDOM COEFFICIENT.......... FOR THE SECOND BLOCK VARIABLES

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| **Results for the model without any random effects** |

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Goodness of fit statistics

Statistic	Value	DF	Ratio
Likelihood Ratio Chi-square	7302.2130	8334	0.8762
Pearson Chi-square	8347.9667	8334	1.0017
Deviance	7302.2130		
Akaike Information Criterion	7312.2130		
Schwarz Criterion	7347.3565		

Estimated regression weights

Parameter	Estimate	Standard Error	z Value	P Value
---------	--------	--------	-------	-------
intcept	3.6217	0.1838	19.7023	0.0000
RELIG	-1.0005	0.0603	-16.5870	0.0000
AGE(15-19)	-0.1736	0.1456	-1.1923	0.2332
AGE(20-34)	0.3294	0.0646	5.0997	0.0000
NOLIVCHC	-0.5581	0.1269	-4.3963	0.0000

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Results for the model with fixed and random effects |

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Goodness of fit statistics

Statistic	Value	DF	Ratio
---------	-----	--	-----
Likelihood Ratio Chi-square	6454.0808	8329	0.7749
Pearson Chi-square	8074.8276	8329	0.9695
Deviance	6454.0706		
Akaike Information Criterion	6464.0706		
Schwarz Criterion	6499.2141		

Estimated regression weights

Parameter	Estimate	Standard Error	z Value	P Value
---------	--------	--------	-------	-------
intcept	3.7087	0.1928	19.2344	0.0000
RELIG	-1.3010	0.0643	-20.2471	0.0000
AGE(15-19)	0.2073	0.1482	1.3984	0.1620
AGE(20-34)	0.4812	0.0687	7.0042	0.0000
NOLIVCHC	-0.8240	0.1336	-6.1667	0.0000

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

NDF	Chi-Square	P Value
---	----------	-------
15	848.1424	0.0000

Estimated level 2 variances and covariances

Parameter	Estimate	Standard Error	z Value	P Value

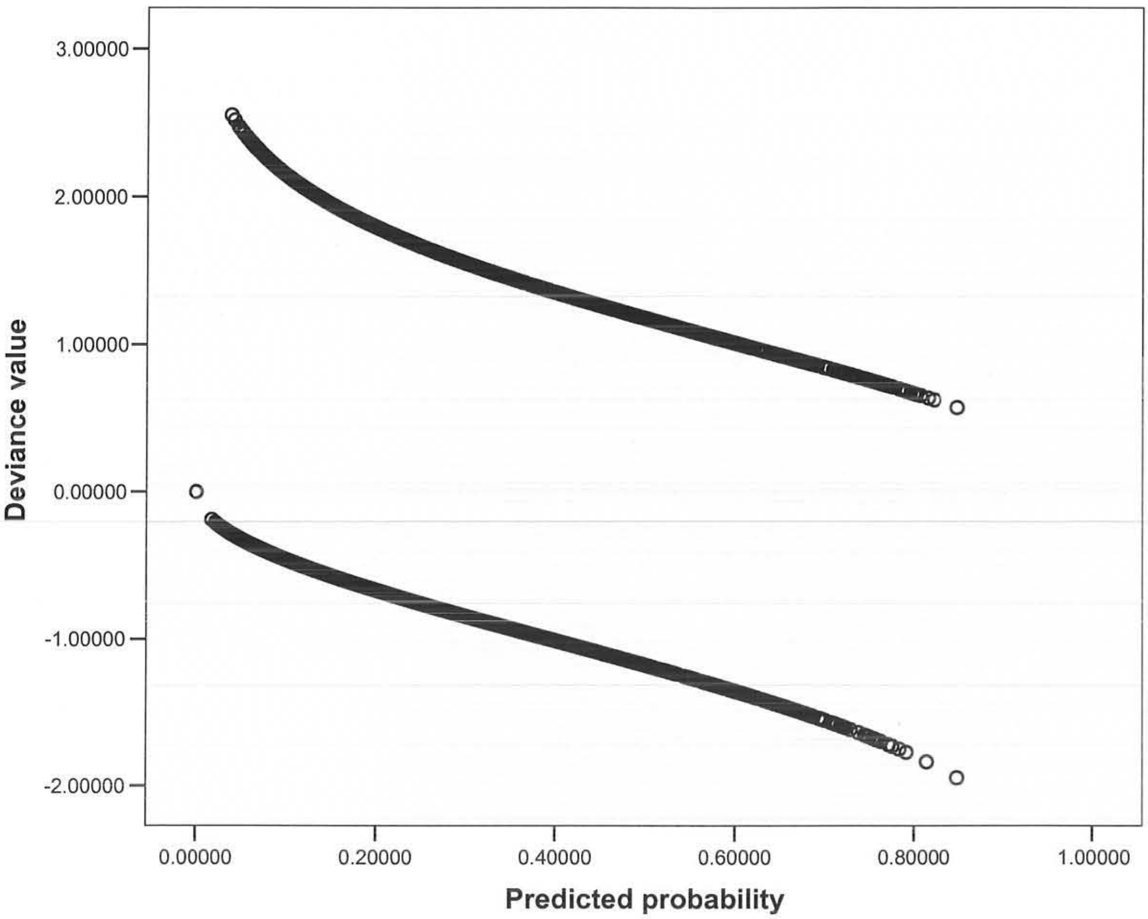
---------	--------	--------	-------	-------
intcept/intcept	4.2534	1.3793	3.0838	0.0020
RELIG/intcept	-2.4698	0.8421	-2.9329	0.0034
RELIG/RELIG	1.7797	0.5699	3.1227	0.0018
AGE(15-19)/intcept	0.0368	0.2332	0.1576	0.8747
AGE(15-19)/RELIG	-0.1566	0.1539	-1.0177	0.3088
AGE(15-19)/AGE(15-19)	0.1838	0.0877	2.0962	0.0361
AGE(20-34)/intcept	-0.1665	0.1498	-1.1115	0.2663
AGE(20-34)/RELIG	-0.0720	0.0946	-0.7604	0.4470
AGE(20-34)/AGE(15-19)	0.0509	0.0384	1.3252	0.1851
AGE(20-34)/AGE(20-34)	0.0944	0.0308	3.0661	0.0022
NOLIVCHC/intcept	0.6716	0.2366	2.8386	0.0045
NOLIVCHC/RELIG	-0.3837	0.1451	-2.6448	0.0082
NOLIVCHC/AGE(15-19)	-0.0169	0.0467	-0.3614	0.7178
NOLIVCHC/AGE(20-34)	-0.0354	0.0287	-1.2344	0.2171
NOLIVCHC/NOLIVCHC	0.1306	0.0497	2.6265	0.0086

Level 2 covariance matrix

	intcept	RELIG	AGE(15-19)	AGE(20-34)	NOLIVCHC
intcept	4.253442				
RELIG	-2.469794	1.779663			
AGE(15-19)	0.036763	-0.156650	0.183823		
AGE(20-34)	-0.166523	-0.071966	0.050947	0.094443	
NOLIVCHC	0.671562	-0.383741	-0.016871	-0.035420	0.130581

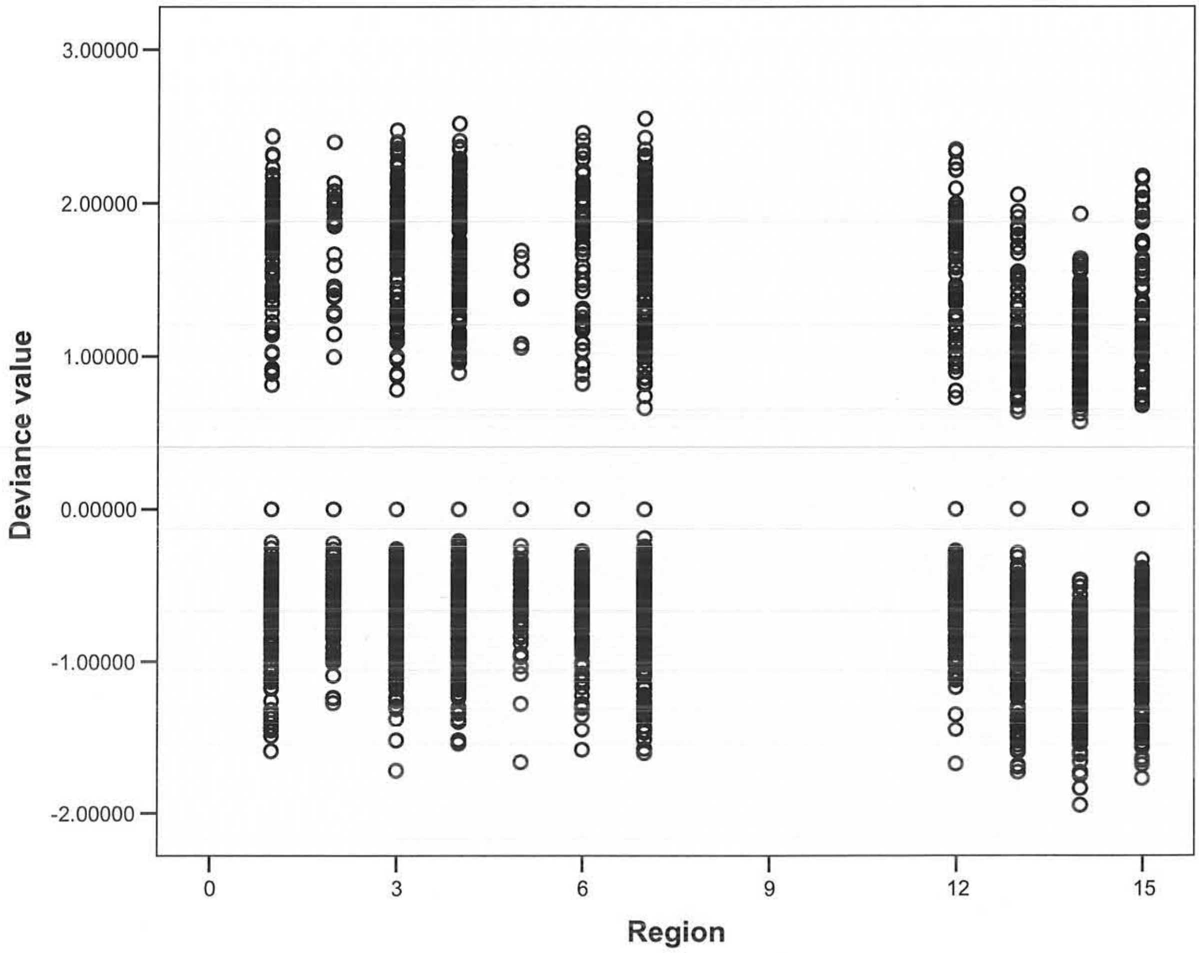
Level 2 correlation matrix

	intcept	RELIG	AGE(15-19)	AGE(20-34)	NOLIVCHC
intcept	1.000000				
RELIG	-0.897680	1.000000			
AGE(15-19)	0.041576	-0.273880	1.000000		
AGE(20-34)	-0.262735	-0.175538	0.386662	1.000000	
NOLIVCHC	0.901106	-0.796028	-0.108895	-0.318950	1.000000

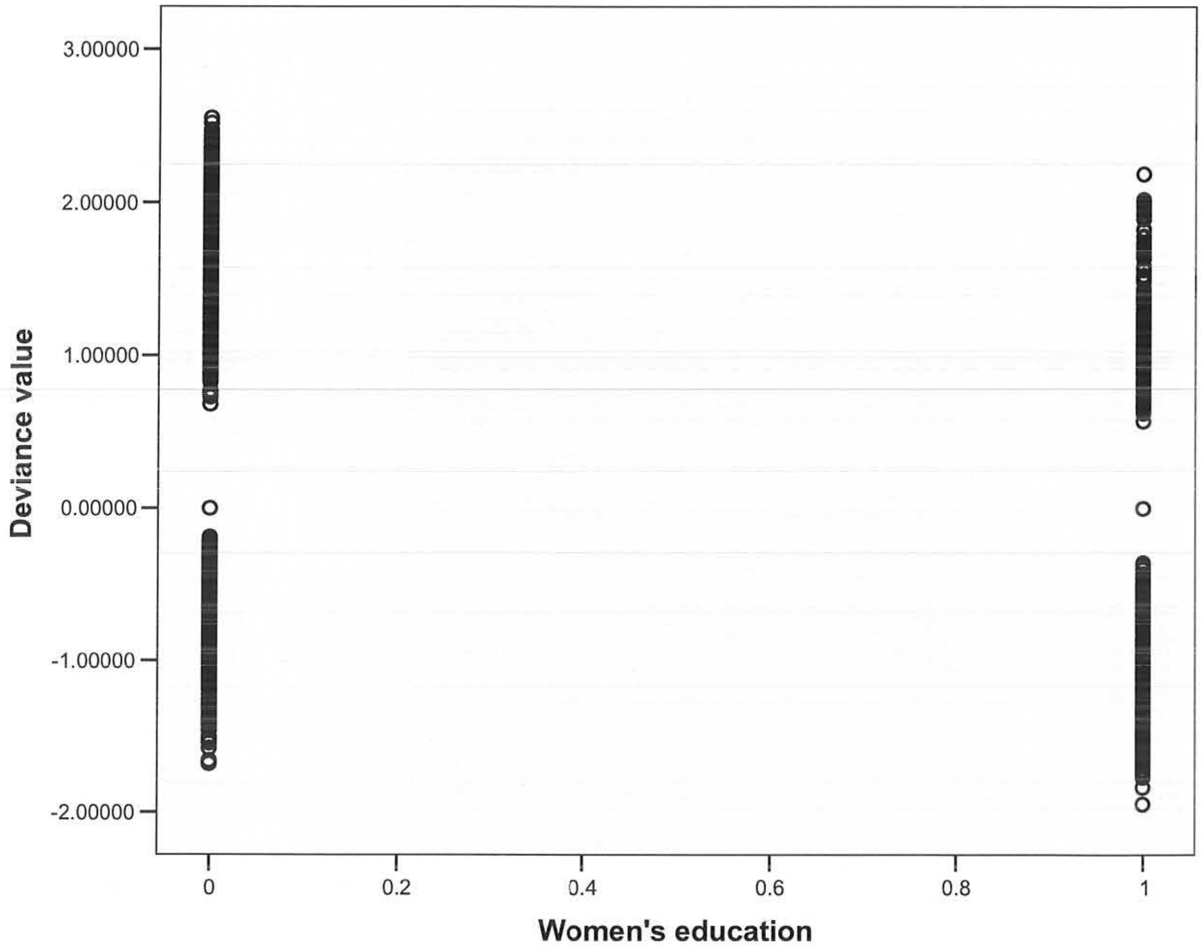


3.00000
2.00000
1.00000
0.00000
-1.00000
-2.00000
Deviance value
0.00000
0.20000
0.40000
0.60000
0.80000
1.00000
Predicted probability

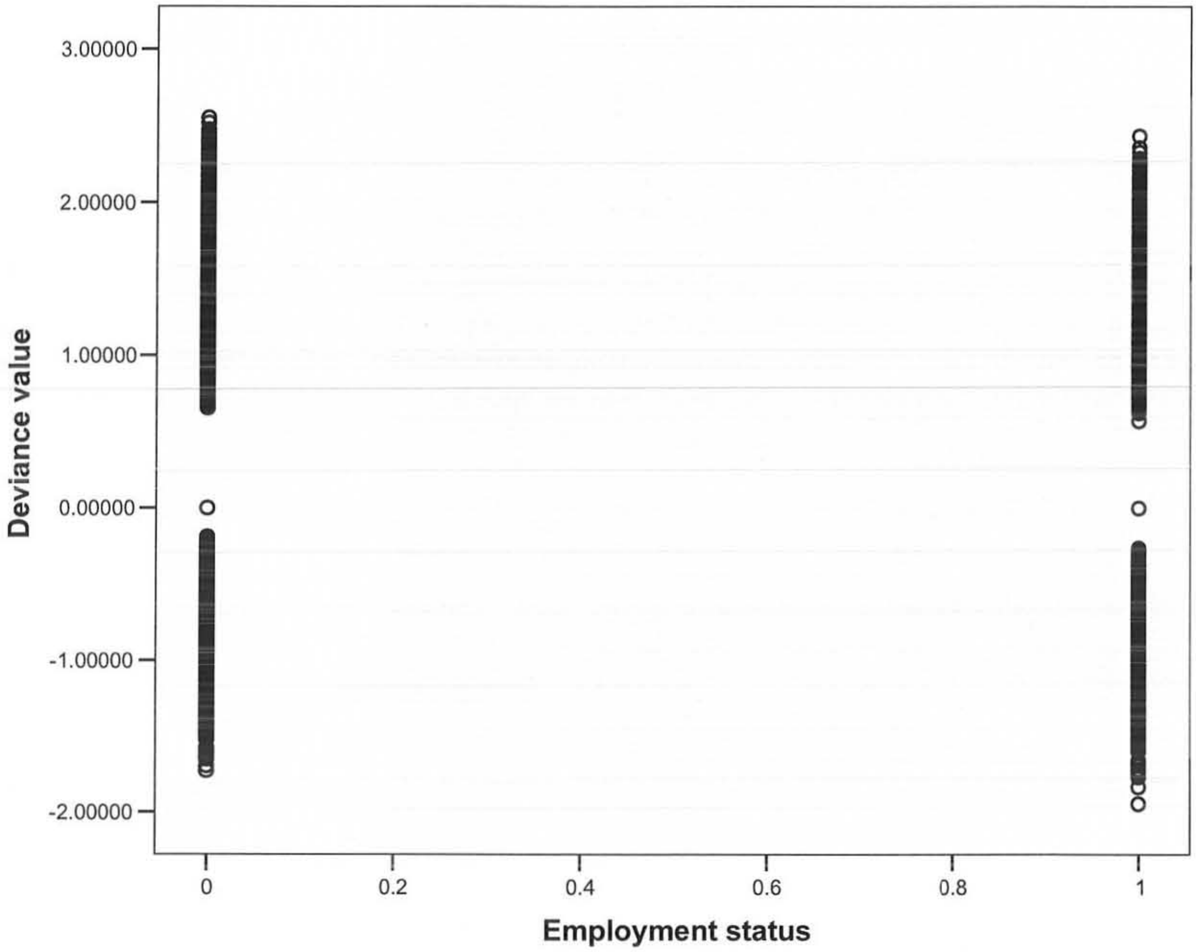
Appendix G: Deviance value against Region



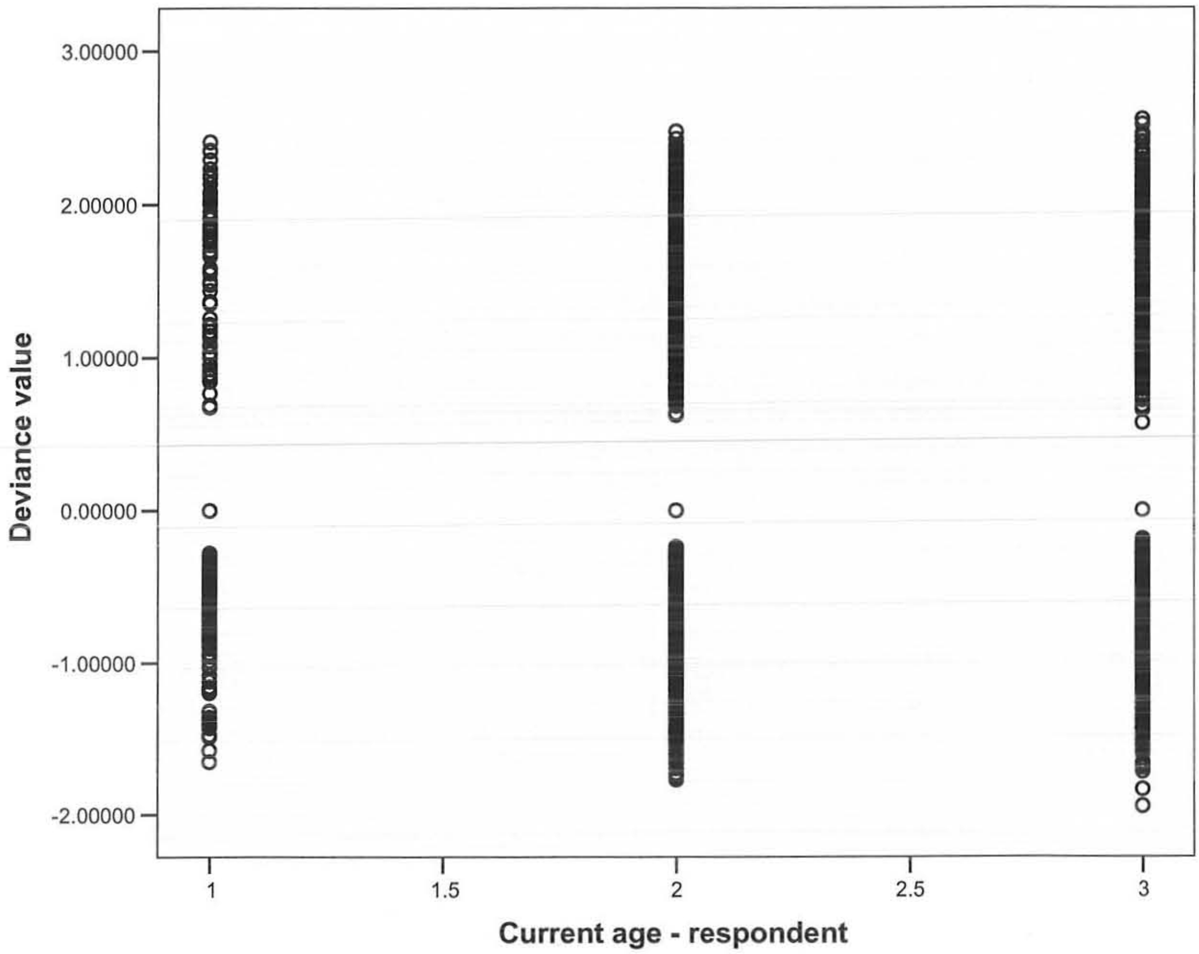
Appendix H: Deviance value against Women's education



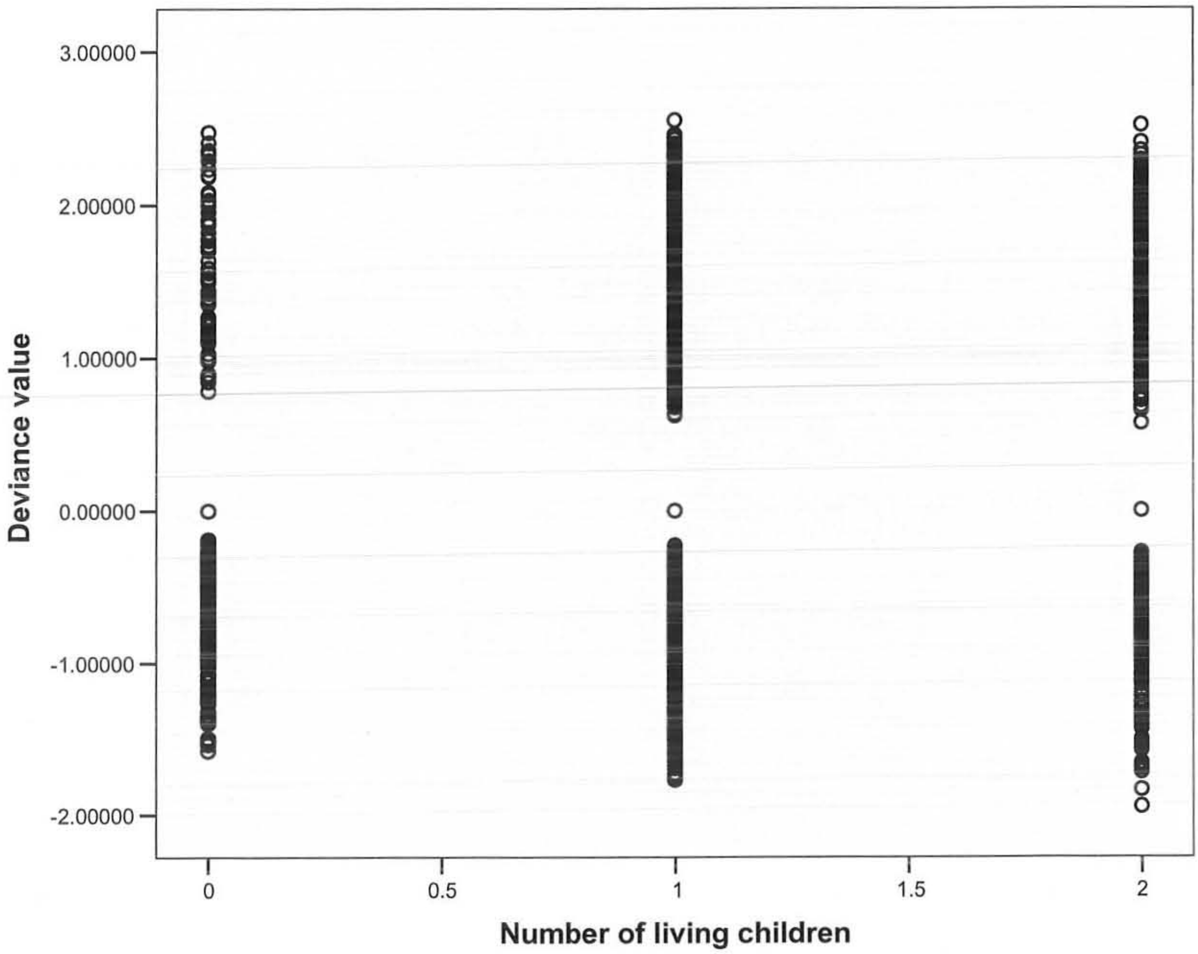
Appendix I: Deviance value against Employment status



Appendix J: Deviance value against Age



Appendix K: Deviance value against NOLIVCH



DECLARATION

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

Name: Getahun Adugna

Signiture:

Place: Faculty of Science, Addis Ababa University

Date: July, 2008

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

Fentaw Abegaz/ Ph.D. /