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Multilevel Logistic Regression Analysis on Predictors of Women's Intention to Limit Child-bearing in Rural Ethiopia

Reta Lemessa Jenbere[1, *], Habte Tadesse Likassa[2]

[1]Department of Statistics, Ambo University, Ambo, Ethiopia

[2]Department of Electronic and Computer Engineering, National Taiwan University of Science and Technology, Taiwan, China

Email address:

lemireta@yahoo.com (R. L. Jenbere)

[*]Corresponding author

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Abstract: The fertility rate of Ethiopia, especially in the rural areas, is unacceptably high. This is leading to negative influence on economic and social development. Thus, understanding those factors that influence the fertility intention of women is important for family planning program purposes and population policy. The main objective of this study was to investigate variability of women's intentions to limit child-bearing in rural Ethiopia between regions and individually. The source of the data was the 2011 Ethiopian Demographic and Health Survey. A weighted sub-sample of 10,864 women was drawn from the DHS women's dataset. The multilevel logistic regression was applied to examine the various factors between intention to limit child-bearing and demographic, socio-economic, and cultural characteristics. From a total of 10,864 women 3,230 (29.7 percent) were intending to limit child-bearing while the remaining 7,634 (70.3 percent) did not. The multilevel logistic regression analysis showed that there were substantial variations in desire to limit child-bearing among eight regions in rural Ethiopia. Accordingly, for empty model, the variance is estimated as $\hat{\delta}^2{}_{u0}$= 0.521 revealing that there was a significant difference in intention to limit child-bearing across regions. The variance of random intercept is estimated at 0.423; this is due to the inclusion of fixed predictor variables indicating that the additional predictors did not increase the percentage of variance explained by the model. Furthermore, either empty model or random intercept model revealed that there was a significance variation in intention to limit child-bearing across the considered regions. Similarly, results of random coefficient for the selected few predictor variables, showed that the number of living children found to be significant in explaining variations in intention to limit child-bearing across the regions. The overall variance constant term is found to be statistically significant. Family planning programs should focus on women with unmet need, particularly those who want to limit child-bearing; avail more information, education and communication about small family norms and the benefits of family planning to achieve the goals of wanted fertility is needed.

Keywords: Intention to Limit Childbearing, Women's Intention, Rural Ethiopia, Multilevel Logistic Regression

1. Introduction

The world population was about 6.8 billion in 2009 and 7 billion in 2012 with 5.6 billion (80 percent) of the world total living in the less developed regions [1]. The population of the more developed regions remained largely unchanged at 1.2 billion inhabitants. The three least developed countries including Bangladesh, Ethiopia, and the Democratic Republic of the Congo were among the ten most populous countries in the world. Thus, whereas the population of more developed regions was rising at an annual rate of 0.34 percent, that of the developing regions was increasing four times as fast, i.e. 1.37 percent annually, and the least developed countries as a group were experiencing even more rapid population growth, at 2.3 percent per year [1].

The desire for large family size is one of the factors influencing fertility in Ethiopia. Thus, understanding factors that influence the fertility intentions of women is important for family planning program purposes and population policy.

Having a large number of children has adversely influenced the socio-economic, demographic and environmental development of the country. Poverty, war and famine, associated with low levels of education and health, a weak infrastructure, and low agricultural and industrial production have exacerbated the problem of overpopulation [2]. Like many other African countries, Ethiopia has so far shown little change in fertility.

The desire to limit child-bearing is expected to be a natural progression in the reproductive life course. The proportion of women who intend to limit child-bearing is one of the most important conditions because it bears directly on population growth and designates a segment of the population that may be at risk of having an unwanted birth. Thus the proportion of women of child-bearing age who want no more children is also an important predictor of fertility levels and trends. In the past few years, the proportion of women who desire to limit child-bearing has been rising in Sub-Saharan Africa.

Measuring fertility intentions, and determining the extent to which they predict fertility behavior, is also important for population policy and the implementation of family planning programs. Substantial evidence from more developed countries and growing evidence from less developed countries shows that preferences are associated with child-bearing behavior, even after accounting for other socio demographic characteristics. However, there is little evidence on how fertility desires predict fertility in sub-Saharan African settings, where rapid and radical socioeconomic changes coupled with a massive HIV/AIDS epidemic have placed immense strains on traditional marital and reproductive systems. In addition, the conditions under which preferences are more strongly or weakly associated with behavior are not well understood [3].

The fertility level of Ethiopia especially in the rural areas is unacceptably high. The total fertility rate (TFR) has fallen below replacement level (2.1 children per woman) in the capital Addis Ababa, but is 3.5 children per woman in the towns, and about 6 children per women in rural areas where 84 percent of the population resides. The higher fertility of women, the more the risk associated with each birth [4].

Fertility is one of the elements in population dynamics that has significant contribution towards changing population size and structure over time. In some of the least developed countries, high fertility rates hamper development and perpetuate poverty, while in some of the richest countries, low fertility rates and too few people entering the job market are raising concerns about prospects for sustained economic growth and the viability of social security systems [1].

Spacing and limiting the number of children improves maternal and child health empowers women and enhances economic development [5].

The situation in Ethiopia indicates that demographic and developmental factors reinforce each other so that high fertility and rapid population growth exert a negative influence on economic and social development. Low levels of economic and social development provide conditions that favor a high fertility rate and rapid population growth. The rapid population growth does not match with available resource in Ethiopia where the economy has been agrarian based on household subsistence farming [6].

Generally, high fertility and rapid population growth have an impact on the overall socio economic development of a country and maternal and child health in particular. Maternal and child mortality are two of the major health problems challenging healthcare organizations, especially in developing countries.

Ethiopia is one of the developing countries with high growth rate of population, high level of maternal and child mortality. Particularly, in rural areas there are many factors that lead to high risk of fertility.

Utilizing the data of the 2011 Ethiopian Demographic and Health Survey we want to study the determinants of women's intention to limit child-bearing in Rural Ethiopia, in order to provide policy makers with base line data important for planning and intervention.

The main objective of this study was to investigate the existence variations due to the random effects at women and regional levels and subsequently, to determine the associated factors of women's intentions to limit child-bearing in rural Ethiopia.

2. Data and Methodology

2.1. Description of the Study Area

Ethiopia is one of the developing counties of the Sub Saharan Africa. According to the World Bank, most of the populations (84%) living in rural areas of the country. Further, those are illiterate society as well as very low using technology. Ethiopia's population has estimated to 90.1 millions. Tigray, Afar, Amhara, Oromia, Benishangul-Gumuz, Gambela, Harari, Somali, Southern Nations Nationalities of Peoples' and city council of Addis Ababa and Dire Dawa are regional divisions of Ethiopia. Ethiopia's economy is based on agriculture. Ethiopia has one of the highest illiteracy rates in the world. The literacy rate among those aged 10 years and above has been reported as 30.9% in rural communities and 74.2% in urban communities [4].

2.2. Source of Data

The data for this study are secondary and were obtained from Ethiopian Demographic and Health Survey (EDHS) 2011 collected by central statistical agency (CSA) with the aim to provide current and reliable data on fertility and family planning behavior, and child mortality, adult and maternal mortality, children's nutritional status, the utilization of maternal and child services, knowledge of HIV/AIDS and prevalence of HIV/AIDS and anemia. The EDHS 2011 was a follow up to the 2000 and 2005 EDHS surveys and provides updated estimates of basic demographic and health indicators. The investigator took a sub-sample from the EDHS 2011 national data that is representative of rural Ethiopia. The survey covered samples of 16,515 women aged 15-49 years out of which 10,864 rural women are included in the study. All rural women (i.e.10, 864) were considered in the study.

2.3. Variables of Interest

The response/dependent variable in the study was women's intention to limit child-bearing in rural Ethiopia. A dummy variable was created from the question of desire for more children. Desire for additional children refers to the proportion of women or couples of reproductive age who want to have a child or another child.

On the basis of answers to these questions respondents were classified into two categories: those who "desired to have child/more children" and those "desiring to limit childbearing".

Based on the available data and literature review this study considered the following characteristics of women as predictor variable:

A demographic characteristic of woman which affects the intention to limit childbearing of women number of living children, previous child death, age of women, region of residence and marital status of a woman.

The socio-economic variables are included in the model, economic status (wealth index), religious belief, occupation status of women, women's education level, and Exposure to mass media.

Other proximate variables are included knowledge of any method, visited by family planning (FP) workers in the last 12 months, and current use of any family planning.

2.4. Multilevel Logistic Regression

a. The Two-Level Model

This introduction is taken from an introduction to basic and advanced multilevel modeling (2nd Edition) [7].

A multilevel logistic regression model also referred to 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. Multilevel modeling relaxes this assumption and allows the effects of these variables to vary across groups. One way to do this uses a generalization of the model developed. We consider two level models for two level data structure: at single woman level and regional level. Assume that there are $j = 1,..., N$ level 2 units and $i= 1,...,n_j$ level 1 units are nested within each level 2 unit. The total number of level 1 observation across level 2 units is given by:

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

Let the response variable for the ith individual in group j be coded as $Y_{ij}= 0$ for the response "desire to have more children"; $Y_{ij}= 1$ for the responses "desire to limit child-bearing". We define.

$$\text{Log}\left(\frac{\pi_{ij}}{1-\pi_{ij}}\right) = \beta_o + \beta_i x_i + U_j \text{ (combined model)} \quad (1)$$

where U_j is the random effect at level two. Without U_j, equation (i) would be a standard logistic regression model. Model (i) is often described alternatively as:

$$\text{logit}\left(\frac{\pi_{ij}}{1-\pi_{ij}}\right) = \beta_{oj} + \beta_i x_i \text{ (level 1 model)} \quad (2)$$

and

$$\beta_{oj} = \beta_o + U_j \text{ (level 2 model} \quad (3)$$

Relative to equations (2) and (3), equation (1) is the so-called combined model [7].

Multilevel models are statistical models, which allow not only independent variables at any level of a hierarchical structure, but also at least one random effect above level one. Multilevel models take account of the variability at each level of the hierarchy and thus allow the provider effects to be analyzed within the models. Thus, multilevel logistic regression analyses allow us to deal with the micro-level of individuals and the macro-level of groups or contexts simultaneously.

The outcome of individual i in group j, which is either 0 or 1, is expressed as the sum of the probability (average proportion of success) in this group plus some individual-dependent residual. This residual has (like all residuals) mean zero but for these dichotomous variables it has the peculiar property that it can assume only the values $-\pi_i$ and $1-\pi_i$. Further, given the value of the probability π_i, the variance of the residual is var (Rij)= $\pi_i(1-\pi_i)$. Since the outcome variable is coded 0 and 1, the group average

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

is the proportion of successes in group j. This is an estimate for the group-dependent probability π_i. Similarly, the overall proportion of success is

$$\hat{\pi}. = \bar{Y}.. = \frac{1}{M}\sum_{j=1}^{N}\sum_{i=1}^{n_j} Y_{ij}.$$

In the above equation M is total sample size [7].

2.5. Types of Multilevel Logistic Regression Models

It must be decided on two aspects, first including which predictors are to be included in the analysis, if any. Secondly, it must be decided whether parameter values (i.e., the elements that will be estimated) will be fixed or random. Fixed parameters are composed of a constant over all the groups, whereas a random parameter has a different value for each of the groups. Additionally, it must be decided whether to employ a maximum likelihood estimation or a restricted maximum likelihood estimation type [8].

i. The Empty model

The null or empty two level model is a model with only an intercept β_0 and random intercepts U_{oj}

$$Logit\left[\frac{\pi_{ij}}{1-\pi_{ij}}\right] = \beta o + U_{oj}$$

The intercept βo is shared by all groups while the random effect U_{oj} is specific to group *j*. The random effect is assumed to follow a normal distribution with variance $\delta^2{}_{o1}$[9].

ii. Random intercepts model

A random intercepts model is a model in which intercepts are allowed to vary, and therefore, the scores on the dependent variable for each individual observation are predicted by the intercept that varies across groups.

This model assumes that slopes are fixed (the same across different contexts). In addition, this model provides information about intra class correlations, which are helpful in determining whether multilevel models are, required in the first place [8].

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

$$Logit\ (\pi_{ij}) = \beta oj + \sum_{h=1}^{k} \beta_h X_{hij}$$

where the intercept term βoj is assumed to vary randomly and is given by the sum of an average intercept βo and group-dependent deviations, U_o that is

$$\beta oj = \beta o + U_{oj}$$

As a result

$$Logit(\pi_{ij}) = \beta o + \sum_{h=1}^{k} \beta_h X_{hij} + U_{oj}$$

Solving for π_{ij}

$$\pi_{ij} = \frac{e^{\beta o + \sum_{h=1}^{k} \beta_h X_{hij} + U_{oj}}}{1 + e^{\beta o + \sum_{h=1}^{k} \beta_h X_{hij} + U_{oj}}}$$

Thus, a unit difference between the X_h values oftwo individuals in the same group is associatedwith a difference of β_h in their log-odds, or equivalently, a ratio of exp (β_h) in their odds. The second equation does not include a level-one residual because it is an equation for the probability π_{ij} rather than for the outcome Y_{ij}. The level-one is already included in the first. Note that the first part of the right-hand side of, incorporating the regression coefficients $\beta o + \sum_{h=1}^{k} \beta_h X_{hij}$ is the *fixed part* of the model, because the coefficients are *fixed.* The remaining part, *U*oj, is called the random part of the model. It is assumed that the residual, *U*oj, are mutually independent and normally distributed with mean zero and variance $\delta_o{}^2$[7].

iii. Random Slope Model

Notice that now the slope is also allowed to vary across regions. The slopes equation specifies that the slope coefficient is a linear combination of the average slope (β) and the regional effect (U).

The random intercept logistic regression model can be extended to a random slope model. Assume that there are *k* explanatory variables X_1 to X_k. Assume that the effect of the first one, X_1, is variable across groups, and accordingly has a random slope.

$$Logit(\pi_{ij}) = \beta o + \sum_{h=1}^{k} \beta_h X_{hij} + U_{oj} + U_{1j} X_{1ij}$$

Then there are two random group effects, the random intercepts U_{oj} and the slope U_{1j}. It is assumed that both have a zero mean. Their variances are denoted by $\delta^2{}_0$, $\delta^2{}_1$ and their covariance is δ_{01}. The model for a single explanatory variable discussed above can be extended by including more variables that have random effects. Suppose that there arelevel-one explanatory variables X_1, X_2, …, X_k. We consider the model where all X-variables have varying slopes and a random intercept

$$Logit(\pi_{ij}) = \beta_{oj} + \beta_{1j} X_{1ij} + \beta_{2j} X_{2ij} + \cdots + \beta_{kj} X_{kij}.$$

by setting $\beta oj = \beta_0 + U_{oj}$ and $\beta hj = \beta_h + U_{hj}$, h= 1, 2,..., k.

Then, $Logit(\pi_{ij}) = \beta_o + \sum_{h=1}^{k} \beta_h X_{hij} + U_{oj} + \sum_{h=1}^{k} U_{hj} X_{hij}$.

The first part of equation $\beta_o + \sum_{h=1}^{k} \beta_h X_{hij}$ is called the fixed part of the model and the second part , $U_{oj} + \sum_{h=1}^{k} U_{hj} X_{hij}$, is called the random part.

3. Results

3.1. Results of Descriptive Analysis

Table 1. *Descriptive statistics of intention to limit child-bearing in rural Ethiopia (n= 10864).*

Variables	Categories	Desire for more children				
		no more		more		Total
		Count	percent	count	Percent	count
Age of women	15-29	955	14.8%	5483	85.2%	6438
	30-39	1158	41.1%	1658	58.9%	2816
	40-49	1117	69.4%	493	30.6%	1610
Region	Tigray	341	25.8%	979	74.2%	1320
	Affar	132	13.1%	876	86.9%	1008
	Amhara	664	38.0%	1084	62.0%	1748
	Oromia	569	33.0%	1155	67.0%	1724
	Somali	62	10.6%	521	89.4%	583
	Beni-Gumuz	333	32.1%	705	67.9%	1038

Variables	Categories	Desire for more children				
		no more		more		Total
		Count	percent	count	Percent	count
	SNNP	601	34.0%	1166	66.0%	1767
	Gembela	261	29.6%	620	70.4%	881
	Harari	133	30.9%	298	69.1%	431
	Dire Dawa	134	36.8%	230	63.2%	364
Educational level of women	No education	2402	35.0%	4466	65.0%	6868
	Primary	796	21.8%	2858	78.2%	3654
	Secondary and higher	32	9.4%	310	90.6%	342
Knowledge ofFP methods	No	208	18.9%	892	81.1%	1100
	Yes	3022	31.0%	6742	69.0%	9764
Wealth index	Poor	2098	32.3%	4389	67.7%	6487
	Middle	935	26.5%	2596	73.5%	3531
	Rich	197	23.3%	649	76.7%	846
No. of living children	None	284	9.1%	2828	90.9%	3112
	1-3	833	21.7%	2999	78.3%	3832
	4 and more	2113	53.9%	1807	46.1%	3920
Visited by FP worker within the last12 months	No	2405	27.4%	6380	72.6%	8785
	Yes	825	39.7%	1254	60.3%	2079
Previous child death	No	2452	30.3%	5633	69.7%	8085
	Yes	778	28.0%	2001	72.0%	2779
Marital status	Never in union	237	10.7%	1982	89.3%	2219
	Currently in union	2408	31.9%	5137	68.1%	7545
	Widowed/separated	585	53.2%	515	46.8%	1100
Exposure to any media	No	1571	27.5%	4148	72.5%	5719
	Yes	1659	32.2%	3486	67.8%	5145
Religion	Coptic Orthodox	1271	33.4%	2538	66.6%	3809
	Protestant	721	31.6%	1559	68.4%	2280
	Muslim	1099	24.8%	3333	75.2%	4432
	Others	139	40.5%	204	59.5%	343
Current use of any methods of FP	No	2575	27.6%	6739	72.4%	9314
	Yes	655	42.3%	895	57.7%	1550
Occupation of women	Not working	1642	30.2%	3787	69.8%	5429
	Agricultural	885	29.5%	2116	70.5%	3001
	Non-agricultural	703	29.9%	1731	71.1%	2434

Out of a total of 10,864 interviewed women 3,230 (29.7 percent) intended to limit child-bearing while 7,634 (70.3 percent) did not intend to limit child-bearing at the time of the survey.

More than half of the women with intention to limit child-bearing are older ages (40-49) 69.4 percent whereas only 30.6 percent did not want to limit child-bearing followed by the age 30-39 (41.1 percent), and the lowest percentage (14.8 percent) with intention to limit child-bearing was observed in the age group 15-29.

Women who lived in different regions also had different levels of desire to limit children. The lowest proportion of desire to limit child-bearing was observed in Somali region (10.6 percent) followed by Affar (13.1 percent). The highest was observed in Amhara region (38.0 percent) followed by Dire Dawa (36.8 percent).

Most women, that is 9,764 (89.9 percent of the total), knew some form of family planning methods. About 69 percent of the women with knowledge of family planning methods wanted more children and about 31 percent wanted to limit child-bearing. It is believed that exposure to any kind of mass media like radio, TV and newspapers and magazines would enhance intention to limit child-bearing. Women who were exposed to any kind of mass media (32.2 percent) were found to have desire to limit child-bearing than those who were not (27.5 percent).

3.2. Results of Multilevel Logistic Regression Analysis

For multilevel analysis involving two levels (e.g. women nested within region), the model can be conceptualized as a two-stage system of equations in which the variation of limiting child-bearing among women within each region is explained by a woman level equation, and the variation across region in the region-specific regression coefficients is explained by a region-level equation.

A chi-square test statistic was applied to assess heterogeneity in the proportion of women who had intention to limit children among the rural regions of Ethiopia. The test yieldχ^2= 378.290. Thus, there is evidence of heterogeneity between regions with respect to intention to limit child-bearing of women.

3.2.1. The Empty Logistic Regression Model

We first fit a simple model with no predictors i.e. an intercept-only model that predicts the probability of intention to limit child-bearing. That is a random intercept or variance components model that allows the overall probability of intention to limit child-bearing to vary across the regions.

From the model estimate for β_0 for a region with U_{oj} = 0 is $\hat{\beta}_0$ = -0.986. This estimating of the intercept provides information that the average probability of intention to limit child-bearing in rural area is exp (-0.986)/ [1+exp (-0.986)] =

0.2717.

Then for region j we have -0.986+U_{oj}, where the variance of U_{oj} is estimated as $\hat{\delta}^2{}_{u0}$= 0.521 revealing that there is a significant difference in intention to limit child-bearing across regions (Somali and Affar left out). This implies that multilevel modeling is appropriate.

The deviance-based chi-square (deviance = 329.09) indicated in above Table is the difference -2LL in deviance between an empty model without random effect and an empty model with random effect. This implies that an empty model with random intercept is better than an empty model without random intercept.

The residual intra-class correlation or ICC is the correlation between two individuals who are in the same higher level unit. The computed ICC= 0.0861 shows that 8.61 percent of the variation in the intention to limit child-bearing can be explained by region (level two). The remaining (100-8.61= 91.9 percent) of the variation of intention to limit child-bearing is explained within the same region.

Table 2. *Results of empty random intercept Logistic regression model analysis, (n= 10864).*

Fixed part	**Coeft.**	**S.E.**	**Z-value**	**P-value**	**[95% CI]**	
$\boldsymbol{\beta_0}$	-.986	.166	-5.91	0.00	-1.313	-.659
Random-part	Estimate	Std. Err	Z-value	P-value		
Level-two variance,$\boldsymbol{\delta^2}_0$=var ($\boldsymbol{U_{oi}}$)	.520	.1214	4.288	0.001		
Deviance-based chi-square	329.09			0.000		

3.2.2. The Random Intercept Model

Here we analyze a model with all lower level explanatory variables fixed. This means that the corresponding variance components of the slopes are fixed at zero. The results of two-level random intercept model presented in Table 3 show that the deviance based chi-square test for significance of random effects (χ^2 =325.36,*df*=1, P<0.05) is reduced; this is an indication of that the model fits better than the previous model.

The variance of random intercept is estimated at 0.423; this is due to the inclusion of fixed predictor variables indicating that the additional predictors did not increase the percentage of variance explained by the model. Therefore, the model shown in Table 3 should be selected as it is the more parsimonious than the empty logistic regression model. All variables except education of women (no education), religion (Muslim), marital status (married) and occupation of women (not working) were found to have a significant effect of variation in intention to limit child-bearing in all regions with respect to the corresponding The reference categories (see Table 3).

Table 3. *Results of random intercept and fixed coefficient logistic regression model (n= 10864).*

Fixed effects Covariate	**Estimate Coefficient**	**S.E.**	**Z-value**	**P-value**	**[95% Conf. Interval]**	
Age of women						
15-29	.7175	.0714	10.05	0.000	.5776	.8574
30-39	2.069	.0892	23.19	0.000	1.894	2.244
40-49 (ref)						
Education of Women						
No education Primary	.0362	.0662	0.55	0.584	-.0934	.1660
Secondary and + (ref)	-.5502	.2065	-2.66	0.008	-.9549	-.1455
Religion						
Coptic orthodox	-.7514	.0719	-10.44	0.000	-.8924	-.6103
Muslim Protestant (ref)	-.2754	.0846	-3.26	0.001	-.4412	-.1096
Wealth index						
Poor	-.1323	.0618	-2.14	0.032	-.2535	-.0110
Middle	-.2404	.1053	-2.28	0.022	-.4468	-.0340
Rich (ref)						
Number of living children						
0	1.565	.1366	11.46	0.000	1.297	1.833
1-3	2.777	.1467	18.93	0.000	2.490	3.065
4+ (ref)						
Knowledge about FP						
No	.2878	.1004	2.87	0.004	.0911	.4847
Yes (ref)						
Use of family planning						
No	.4174	.0717	5.83	0.000	.2771	.5578
Yes (ref)						
Media exposure						
No	.1314	.0552	2.38	0.017	.0232	.239
Yes (ref)						
Any death of children						
No	-1.070	.0644	-16.61	0.000	-1.197	-.9441
Yes (ref)						
Marital status						
Never in union Married	-1.094	.1496	-7.31	0.000	-1.387	-.8009

Fixed effects Covariate	Estimate Coefficient	S.E.	Z-value	P-value	[95% Conf. Interval]	
Widowed /separated (ref)	.2342	.1525	1.54	0.125	-.0647	.5332
Visited by FP worker						
No	.2241	.0642	3.49	0.000	.0983	.3498
Yes (ref)						
Occupation of women						
Not working Agricultural	-.0461	.0611	-0.75	0.451	-.1658	.0736
Non-agricultural (ref)	-.1611	.0658	-2.44	0.014	-.2901	-.0319
Constant	-2.438	.2509	-9.72	0.000	-2.929	-1.946
Random Part	Estimate Variance Component		S.E.	Z-value	P-value	
Random Intercept:$\delta^2{}_0$=var (U_{oi})	.4234		.1969	2.149	0.032	
Deviance-based chi-square	325.36				0.000	

3.2.3. Random Coefficients

This section provides information about the variability of intention to limit child-bearing among regions, taking into consideration the estimated coefficients. We find out that the effect of number of living children, current use of FP, media exposure and being visited by FP workers vary across regions. So, we need to include random coefficients to the model containing number of living children, current use of FP, media exposure and being visited by FP workers to vary randomly across regions. Based on the results in Table 4 it can be concluded that although the fixed part of the random coefficients are significant there is a large uncertainty about the variance of random parts.

Table 4. *Results for Fixed and Random Effects of Random Coefficient Model (n= 10864).*

Fixed effects Covariates	Estimate Coefficient	S.E.	Z-value	P-value	[95% C. I]	
Age of women						
15-29	.7268	.0716	10.15	0.000	.5865	.8672
30-39	2.083	.0896	23.25	0.000	1.907	2.258
40-49 (ref)						
Education of Women						
No education	.0401	.0664	0.60	0.546	-.0900	.1702
Primary	-.5263	.2065	-2.55	0.011	-.9310	-.1216
Secondary and + (ref)						
Religion						
Coptic orthodox	-.1770	.0971	-1.82	0.068	-.3672	.0132
Muslim	.0714	.1587	0.450	.653	-.2397	.3824
Protestant (ref)						
Wealth index						
Poor	-.1104	.0623	-1.77	0.076	-.2324	.0116
Middle	-.2558	.1056	-2.42	0.015	-.4628	-.0487
Rich (ref)						
No. of living children						
0	1.587	.1376	11.53	0.000	1.317	1.857
1-3	2.813	.1479	19.01	0.000	2.523	3.103
4+ (ref)						
Knowledge about FP						
No	.2482	.1012	2.45	0.014	.0498	.4465
Yes (ref)						
Use of family planning						
No	.6696	.2092	3.20	0.001	.2596	1.079
Yes (ref)						
Media exposure						
No	.1437	.0554	2.59	0.010	.0351	.2524
Yes (ref)						
Any death of children						
No	-1.077	.0646	-16.65	0.000	-1.203	-.9498
Yes (ref)						
Marital status						
Never in union	-1.109	.1506	-7.360	0.000	-1.405	-.8139
Married	.2225	.1530	1.45	0.146	-.0775	.5225
Widowed /separated (ref)						
Visited by FP worker						
No	.3583	.123	2.89	0.004	.1153	.6014
Yes (ref)						
Occupation of women						
Not working	-.0473	.0612	-0.77	0.440	-.1674	.0727

Fixed effects Covariates	Estimate Coefficient	S.E.	Z-value	P-value	[95% C. I]	
Agricultural	-.1583	.0660	-2.40	0.017	-.2877	-.0288
Non-agricultural (ref)						
Constant	-2.490	.2646	-9.41	0.000	-3.009	-1.972
Deviance-based chi-square	348.650.000					
Random Part	Coefficient	S.E.		Z-value	P-value	
$\delta^2{}_0$=var (U_{oi})	.5488	.2510		2.186	0.028*	
$\delta^2{}_1$=var (U_{1i})	.2302	.1161		1.982	0.047*	
$\delta^2{}_2$=var (U_{2i})	.3415	.2694		1.268	0.206	
$\delta^2{}_3$=var (U_{3i})	.0100	.0089		1.124	0.258	
$\delta^2{}_4$=var (U_{4i})	.1038	.0916		1.133	0.250	
$\delta^2{}_{01}$=cov ($U_{oi.}U_{1i}$)	-.1481	.1181		-1.254	0.209	
$\delta^2{}_{02}$=cov ($U_{oi.}U_{2i}$)	-.3159	.2075		-1.522	0.128	
$\delta^2{}_{03}$=cov ($U_{oi.}U_{3i}$)	-.0627	.0277		-2.263	0.023*	
$\delta^2{}_{04}$=cov ($U_{oi.}U_{4i}$)	.0485	.07121		0.682	0.494	
$\delta^2{}_{12}$=cov ($U_{1i.}U_{2i}$)	-.1092	.0946		1.154	0.250	
$\delta^2{}_{13}$=cov ($U_{1i.}U_{3i}$)	-.0175	.0290		0.742	0.515	
$\delta^2{}_{14}$=cov ($U_{1i.}U_{4i}$)	-.1296	.0801		-1.621	0.128	
$\delta^2{}_{23}$=cov ($U_{2i.}U_{3i}$)	.0220	.0245		0.899	0.373	
$\delta^2{}_{24}$=cov ($U_{2i.}U_{4i}$)	.1882	.1432		1.314	0.183	
$\delta^2{}_{34}$=cov ($U_{3i.}U_{4i}$)	.0137	.0176		0.780	0.435	

* Statistically Significant at ($p<0.05$)

In Table 4 above, the value of Var (U_{0j}), Var (U_{1j}), Var (U_{2j}), Var (U_{3j}) and Var (U_{4j}) are the estimated variance of intercept, slope of number living of children, slope of use of family planning, slope of media exposure and slope of visited by FP worker in the last 12 months respectively. The overall variance constant term is found to be statistically significant. Also, we observed that the random effect of the slope of number of living children vary significantly at 0.05 levels of significance across regions. Using FP methods, exposure to any media and women who were visited by FP workers have no almost variation across the regions (i.e. not significant at the level of 0.05) (see Table 4).

The correlation matrix contains the estimated correlations between random intercepts and slopes (see Table 5). The correlation between the intercept and random slope of visited by FP workers is 0.2034, meaning that women who were visited by FP workers within 12 months before the survey had the intention to limit child-bearing than those who did not 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.

Women who had access to use any family planning methods through mass media and who had been visited by FP worker were more likely to desire to limit number of children.

Table 5. *The correlation matrix of the random coefficients (n= 10864).*

	Intercept	No of living children	Use of FP	Media	Visited by FPW
Intercept	1.000				
No of living children	-0.4167	1.000			
Use of FP	-0.7297	-0.3901	1.000		
Media	-0.8469	-0.3656	0.4330	1.000	
Visited by FPW	0.2034	-0.8389	0.9991	0.4270	1.000

4. Discussion

The descriptive analysis revealed from a total of 10,864 women 3,230 (29.7 percent) were intending to limit child-bearing while the remaining 7,634 (70.3 percent) did not. Age, religion, educational attainment, knowledge about family planning methods, wealth index, exposure to media, number of living children, previous child death were found as the major factors women's intention to limit child-bearing in rural Ethiopia. This finding is similar to findings of other study [10, 11]. Similarly, visited by FP workers during the last 12 months, marital status, current usage of any FP method, occupation status of women were found to be the predictors of women's intention to limit child-bearing in rural Ethiopia. This finding is in agreement with study in rural Rwanda [12] and in many countries in Africa [13].

Although the study was undertaken only in rural areas there are differences in intention to limit child-bearing among rural areas of the regions. The lowest intentions to limit child-bearing were observed in Somali (10.6 percent) and Affar (13.1 percent) regions. This means that the intention to limit child-bearing was not significant in Affar and Somali regions. Muslim women had low intention to limit child-bearing. Women who live in Somali and Affar are predominantly Muslims. A study with similar results found that in Kenya and Tanzania, Muslim women desire more children than Christians [14].

The majority of the women with the intention to limit children belonged to the ages 40-49 (69.4 percent) and those women who had four or more living children (53.9 percent). This observation is not surprising because the fertility behavior of older women is more consistent with intentions than that of younger women [15]. Results from the random effect multilevel analysis took into account the hierarchical structure of the data as well as the variability within each region and individual levels to estimate the levels of association of the study factors with the outcome. In general, the fixed effects of the explanatory variables included in the multilevel models revealed variations in intention to limit child-bearing in all regions.

The random intercept and the coefficient provided additional information. The variances of the random components related to the random term were found to be statistically significant implying presence of differences in intention to limit childbearing across the regions. On other hand, from explanatory factors considered here, the effect of the age of women, wealth index, number of living children and women exposure to media differs from region to region[16, 17].

The overall variance of the constant term in the empty model with random intercept only, in random intercept and fixed slope model indicated the existence of differences in intention to limit child-bearing among women in rural areas. A random intercept and fixed slope model was also employed to compare the status of limiting child-bearing among regions. The deviance-based chi-square test for significance of random effects indicated that the random intercept model with the fixed slope provided a better fit compared to the empty model. The inclusion of fixed predictor variables indicated that all predictors had significant effect to determine the variation in limiting child-bearing among regions.

The effect of regional variations for religion, place of residence, visited by FP worker and media exposure further implies that there exist considerable deference in intention to limit childbearing among regions and a model with a random coefficient or slope is more appropriate to explain the regional variation than a model with fixed coefficients or without random effects.

5. Conclusion

In general, the results of the random slope multilevel logistic regression suggest that there exist significant differences in intention to limit childbearing rural Ethiopia among women. This analysis indicated that there is desire for limiting child-bearing among women in rural Ethiopia, particularly among older women and those who had large families.

Recommendations

The following points are highly recommended:

- Provide family planning services to women who have achieved their fertility goals would be important for reducing unwanted fertility.
- Enhance information and communication activities regarding family planning services using media, health extension workers and health centers in rural Ethiopia.
- Family planning programs should focus on women with unmet need, particularly those who want to limit child-bearing; avail more information, education and communication about small family norms and the benefits of family planning to achieve the goals of wanted fertility is needed.
- Further study is required to assess the quality related to limit child-bearing in the whole Ethiopia.

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