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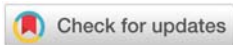***Corresponding author:** Tezera Abebe Gashaw, Department of Statistics, College of Natural and Computational Science, Wolkite University, Ethiopia, Email: tezera07@gmail.com

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Research Article

Statistical analysis of early marriage among women in Ethiopia by using multilevel logistic regression

Abstract

Early marriage is still widely practiced in many parts of the world mainly in Latin America, the Caribbean, Southern Asia and countries of Africa. Ethiopia has one of the highest rates of early marriage in Sub-Saharan Africa. The main objective of this study was to identify determinants of early marriage among women in Ethiopians and to examine variations in early marriage between and within regions of Ethiopia. The study is made based on the Ethiopian Demographic and Health Survey 2011 data that has two stages sampling hierarchical structure, collected for 9262 married women nested within eleven regions with age 15-49 years. Descriptive statistics and multilevel logistic regression model analysis were used to examine the prevalence and identify determinants of early marriage. The results of descriptive statistics shows that Out of the 9,262 married women, 3320(35.8%) of marriages occur 18 years and above while 5942 (64.2%) of these women married early (under 18 years) at the time of the survey. The multilevel logistic regression analysis showed that there is a significant difference in early marriage across regions. Accordingly, for empty model, the variance is estimated as σ_0^2 =0.3077789, p-value=0.0108 revealing that there was a significant difference in early marriage across 11 regions. The variance of random intercept is estimated at 0.160928, p-value=0.012. 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 early marriage across regions. Similarly, results of random coefficient for the selected few predictor variables, showed that women's education level found to be significant in explaining variations in early marriage across the regions. As a result special attention needs to be paid, in particular, to the regions' access to education for young women and information on reproductive health to reduce early marriage.

Introduction

Marriage is an important institution for the individual and the society at large. For the individual, it is a significant and memorable event in one's life cycle as well as the most important foundation in the family formation process. Age at marriage is of particular interest because it marks the transition to adulthood in many societies; the point at which certain options in education, employment, and participation in society are foreclosed; and the beginning of regular exposure to the risks of pregnancy and childbearing. For the society as a whole, it unites several individuals from different families and represents the creation of a production and consumption unit as well as one for the exchange of goods and services [1].

The term "early marriage" is used to refer to both formal marriages and informal unions in which a girl lives with a partner as if married before age of 18 [2]. Early marriage, also known as Child marriage, is defined as "any marriage carried out below the age of 18 years, before the girl is physically, physiologically,

and psychologically ready to shoulder the responsibilities of marriage and childbearing." Child marriage, on the other hand, involves either one or both spouses being children and may take place with or without formal registration, and under civil, religious or customary laws [3]. Early marriage affects millions of children through the world. It is widely practiced in the countries of South Asia where every year millions of girls–preteens and teens become the wives of older men. Early marriage compromises their development and often results in early pregnancy and social isolation, with little education and poor vocational training reinforcing the gendered nature of poverty. Required to perform heavy amounts of domestic work, under pressure to demonstrate fertility, married girls and child mothers face constrained decision–making and reduced life choices. Both boys and girls are affected by child marriage but the issue impacts girls in far larger numbers, with more intensity and is wide ranging [2]. Early marriage is still widely practiced in many parts of the world but remains prevalent in countries of Africa, Latin America and the Caribbean as well as Southern Asia and predominantly affects girls. It is estimated

that, if nothing changes, a 100 million young girls aged 15 years or less will be married within the present decade [4]. Regional estimates of its occurrence for girls include 48% in Southern Asia, 42% in Africa and 29% in Latin America and the Caribbean with wide differentials across the countries. In the West African sub-region, the proportions of girls affected vary from 28% - 43% (Ghana, Togo, Cote d'Ivoire, Senegal, Benin, Nigeria) to 60-80% (Burkina Faso, Guinea, Mali, Chad and Niger) [2].

Current estimates show that approximately 82 million girls between 10–17 years will be married before they reach 18 years. Of the 331 million girls aged 10–19 in developing countries (excluding China), 163 million will be married before they are 20 .Although early marriage is predominantly a female problem, a minority of boys may also be forced to marry early [5].

Ethiopia has one of the highest rates of early marriage in Sub-Saharan Africa. A study by the National Committee on Harmful Traditional Practices of Ethiopia (NCTPE) estimated the proportion married before the age of 15 at 57 percent. The same study shows that the practice occurs in its more extreme forms in northern Ethiopia, where girls are married as young as eight or nine years of age. In some instances, they are even pledged at birth [6]. Although early marriage is widely practiced in many parts of the country, rates in Amhara and Tigray region are much higher than the national average (82 percent in Amhara, 79 percent in Tigray, 64 percent in Benshangul, 64 percent in Gambella and 46 percent in Afar [6].

Women who marry early will have, on average, a longer period of exposure to the risk of pregnancy, often leading to higher fertility. Historically, societies with later age at first marriage have experienced decreased fertility rates while in traditional populations in Asia and Africa where age at first marriage is younger, high levels of fertility has been observed [7-9]. Many demographers and scholars recommend the need to conduct in-depth studies on the risk factors of early marriage among women for both developing and developed countries. Child marriage is a health issue as well as a human right violation. Because it takes place almost exclusively within the context of poverty and gender inequality, it also has social, cultural and economic dimensions. Most countries, including Ethiopia, have declared 18 as a minimum legal age of marriage.

In Ethiopia marriage is universal and occurs early). In 2005, for instance, among women aged 25 – 49, 66% married by before age 18 while the proportion married by age 20 is 79% with median age at first marriage of 16.1 years [10].

The people of Ethiopia are multi-ethnic and multi-cultural. Due to the multi-ethnic and multi-cultural nature of the society, the ways of controlling early marriage varies within societies (women) and across regions. Moreover, socio-economic and demographic factors on early marriage may cause variation at individual and regional levels. Yet, there is no study conducted about early marriage among women in Ethiopia particularly about the effects of socio- economic, and demographic factors aiming at identifications of individual and regional variations.

Therefore, this study is an attempt to fill the research gap by identifying the socio-economic and demographic factors of early marriage, the extent of variations and the factors that vary across regions of Ethiopia. This intern helps to increase age at first marriage (decrease early marriage).

Data and Methodology

Data

In this study, data of the 2011 Ethiopia Demographic and Health Survey (EDHS) were used. This two stage sampling 2011 EDHS dataset is of hierarchical structure. The hierarchy for this study follows individuals/women as level-1, and regions as level-2. This means that individuals are nested in regions. From among the 16,702 households, 16,515 women were identified as eligible for the individual interview. Interviews were completed with 16,515 women, yielding a response rate of 95 percent. Thus, the analysis presented in this study on early marriage among women is based on 9262 married women in Ethiopia. The data is analyzed using SPSS software Packages (version 20.0) and STATA 11 software.

Study variables

Dependent variable: During the survey all women were asked a series of questions regarding their marital status and whether they had ever lived with a man. All those who reported that they were ever married or ever-lived with a man, were asked to indicate how old they were at the time when they started, for the first time ever, living with a man as a wife, irrespective of the legality or otherwise of their union. The response to this question constitutes the woman's age at first marriage. All the women who indicated that they had never been in a union or lived with a man were considered single and as a result they were not asked the question about the age at first marriage. This is the standard way in which age at first marriage is being measured in the worldwide DHS program [1].

Independent variables: considered for this analysis include women's education level, Husband's education level, Husband's occupation ,wealth index , Respondents work status, region, religion, type of residence, number of siblings and exposure to any mass media.

Multilevel logistic regression model

In this analysis, a multilevel statistical approach was used to model the relation between age at first marriage and the explanatory variables. Two levels of data hierarchy were stated (for instance individual women and region) in a multilevel logistic regression model. Units at one level are nested within units at the next higher level. In this study the basic data structure of the two-level logistic regression is a collection of N groups (regions) and within-group j(j=1,2,3,...N),a random sample of n_j of level-one units(individual women). The response variable is denoted by Y_{ij}

$$Yij = \begin{cases} 1, & if\ age\ at\ first\ marriage\ is\ under\ 18\ years \\ 0, & if\ age\ at\ first\ marriage\ is\ 18\ and\ above\ years \end{cases}$$

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 [11].

The Empty model: The null or empty two level model is a model with only an intercept B_0 and random intercepts U_{0j}.

$$Logit\left(p_{ij}\right) = \beta_0 + U_{oj} \dots\dots\dots\dots\dots(1)$$

The intercept B_0 is shared by all groups while the random effect U_{0j} is specific to group j. The random effect is assumed to follow a normal distribution with variance σ_{01}^2 [13].

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

In addition, this model provides information about intra class correlations, which are helpful in determining whether multilevel models are, required in the first place [11].

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

$$logit(P_{ij}) = \log\left(\frac{p_{ij}}{1 - p_{ij}}\right) = \beta_{oj} + \sum_{h=1}^{k} \beta_h x_{hij} \dots\dots(2)$$

Where the intercept term σ_{01}^2 is assumed to vary randomly and is given by the sum of an average intercept β_0 and group-dependent deviations U_{oj}, that is

$$\beta_{oj} = \beta_0 + U_{oj}$$

As a result we have:

$$logit\left(P_{ij}\right) = \beta_0 + \sum_{h=1}^{k} \beta_h x_{hij} + U_{oj} \dots(3)$$

Solving for we have:

$$P_{ij} = \frac{e^{\beta_0 + \sum_{h=1}^{k} \beta_h x_{hij} + U_{oj}}}{1 + e^{\beta_0 + \sum_{h=1}^{k} \beta_h x_{hij} + U_{oj}}} \dots\dots(4)$$

Thus, a unit difference between the X_h values of two individuals in the same group is associated with a difference of β_h in their log-odds, or equivalently, a ratio of $\exp(\beta_h)$ in their odds.

Equation (3) does not include a level-one residual because it is an equation for the probability P_{ij} rather than for the outcome Y_{ij}. Note that in the above equation, $\beta_0 + \sum_{h=1}^{k} \beta_h x_{hij}$ is the fixed partof the model. The remaining U_{oj} is called the random partof the model. It is assumed that the residual U_{oj} are mutually independent and normally distributed with mean zero and variance σ_0^2 [12].

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). Consider explanatory variables which are potential explanations for the observed outcomes. Denote these variables by. $X_1, X_2,\dots,X_k$. The values of $X_h (h = 1, 2, \dots, k)$ are indicated in the usual way by X_{hij}. Since some or all of these variables could be level-one variables, the success probability is not necessarily the same for all individuals in a given group. Therefore, the success probability depends on the individual as well as the group, and is denoted by P_{ij}. Now consider a model with group-specific regressions of logitof the success probability, $logit(P_{ij})$, on a single level one explanatory variable X,

$$logit\left(P_{ij}\right) = \beta_0 + \sum_{h=1}^{k} \beta_h x_{ij} + U_{oj} + U_{1j} x_{1ij} \dots \quad (5)$$

There are two random group effects, the random intercept U_{0j} and the random slope U_{1j}. It is assumed that the level two residuals U_{oj} and U_{1j} have both zero mean given the value of the explanatory variable X. Thus, β_1 is the average regression coefficient like β_0 is the average intercept.

The first part of equation (5), $\beta_0 + \beta_1 x_{1ij}$ is called the fixed part of the model whereas the second part $U_{oj} + U_{1j} x_{1ij}$ is called the random part of the model.

The term $U_{oj} + U_{1j} x_{1ij}$ can be regarded as a random interaction between groupand predictors (X) and their variances and covariance of the level-two random effects (U_{oj}, U_{1j}) are denoted by:

$$Var\left(U_{oj}\right) = \sigma_{00} = \sigma_0^2$$

$$Var\left(U_{1j}\right) = \sigma_{11} = \sigma_1^2$$

$$Cov\left(U_{oj}, U_{1j}\right) = \sigma_{01}$$

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

$$logit\left(P_{ij}\right) = \beta_{oj} + \beta_{1j} x_{1ij} + \beta_{2j} x_{2ij} + \dots + \beta_{kj} x_{kij} \dots\dots\dots(6)$$

Letting $\beta_{oj} = \beta_0 + U_{oj}$ and $\beta_{hj} = \beta_h + U_{hj}$ where $h = 1, 2,\dots, k$, we have:

$$logit\left(P_{ij}\right) = \beta_0 + \sum_{h=1}^{k} \beta_h x_{ij} + U_{oj} + \sum_{h=1}^{k} U_{hj} x_{ij} \dots\dots(7)$$

The first part $\beta_0 + \sum_{h=1}^{k} \beta_h x_{ij}$ is called the fixed part of

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the model, and the second part, $U_{oj} + \sum_{h=1}^{k} U_{hj}x_{ij}$ is called the random part of the survey.

Results of descriptive analysis

Out of a total of 9,262 married women, 3320(35.8%) of marriages occur 18 years and above while 5942 (64.2 %) of these women married early (under 18 years) at the time of the survey.

The proportion of early marriage differed by place of residence. The prevalence of early marriage was higher among women who were residing in rural areas (68.6%) were as women who residing in urban area (48.3%).The proportion of early marriage of women varied from one region to the other in Ethiopia. The highest proportion (85.5%) of early marriage women was observed in Amahara followed by Benshangul–Gumez (72.3%) and the least proportion (37.4%) of early marriage was observed in Addis Ababa, followed by Dire Dawa (47.2%). Hence, there appears to be some variation in the proportion of early marriage among women in different regions of Ethiopia. Table 1 also reveals that early marriage varies by their educational status of women. The highest percentage of early marriage observed in women who have no education (69.5%) as opposed to the lowest percentage of early marriage which was recorded for women who have higher education level (16.8%) Similarly, we see that nature of early marriage varies by their Husband's education level. The highest percentage of Husband's education level was observed among those women whose husbands have no education (69.8%) as opposed to the lowest percentage of early marriage which was recorded from women whose husband education level which have high (36.7%). With regard to exposure to mass media, the highest percentage of early marriage was observed for women who have no any exposure to mass media (68.6%) and lower percentage of early marriage which was recorded for women who have any exposure to mass media (61%).

The proportion early marriage depends on husband's occupation. The highest percentage of early marriage was observed among those women whose husband/partners occupation have Agriculturalists (69.5%) as opposed to the lowest percentage of early marriage which was recorded from women whose husband occupation have Professional (50.8%).

Results of multilevel logistic regression analysis

The data used in this study have a hierarchical structure. Units at one level are nested within units at the next higher level. Here, the lower level (level-1) units are the Individualwomen and the higher level (level-2) units are the regions that constitute the groups into which the women are clustered or nested. The nesting structure is women within regions that resulted in a set of 11 regions with a total of 9262 women.

Before we proceed to multilevel logistic regression analysis, we need to test the heterogeneity age at first marriage among women across eleven regions of Ethiopia.

Table 1: Descriptive Characteristics of Married Women in the Age Group 15-49 (EDHS, 2011).

Variable	Categories	Age at first marriage		Total
		Early Marriage (%)	Legal Marriage (%)	
Place of resident	Urban	987(48.3)	1057(51.7)	2044
	Rural	4955(68.6)	2263(31.4)	7218
Religion of a woman	Orthodox	2231(66.7)	1115(33.3)	3346
	Muslim	2654(65)	1429(35)	4083
	Protestant	918(57.4)	673(42.6)	1591
Region	Others	139(57.7)	103(42.3)	242
	Tigry	610(65)	329(35)	939
	Affar	628(67.1)	308(32.9)	936
	Amahara	1070(85)	189(15)	1259
	Oromia	836(63)	490(37)	1326
	Somali	376(61)	240(39)	616
	Ben-Gumes	623(72.3)	239(27.7)	862
	SNNP	564(52.3)	515(47.7)	1079
	Gambela	447(69.2)	199(30.8)	646
	Hararie	348(62.6)	208(37.4)	556
	Addis Abeba	198(37.4)	332(62.6)	530
	Dire Dawa	242(47.2)	271(52.8)	513
Women's Education level	None	4249(69.5)	1868(30.5)	6117
	Primary	1486(62.3)	900(37.7)	2386
	Secondary	155(34.4)	295(65.6)	450
	Higher	52(16.8)	254(83.2)	309
Husband's education level	None	3310(69.8)	1429(30.2)	4739
	Primary	2070(64.3)	1154(35.7)	3229
	Secondary	350(47.9)	380(52.1)	730
	Higher	207(36.7)	357(63.3)	564
Wealth index	Poorest	1723(67.5)	830(32.5)	2553
	Poorer	1125(72.5)	433(27.8)	1558
	Middel	1010(69.4)	446(30.6)	1456
	Rich	1039(70.5)	444(29.5)	1483
	Richest	1045(47.3)	1167(52.8)	2212
Respondents work Status	Not working	4225(67)	2080(33)	6305
	Working	1717(58.1)	1240(41.9)	2957
exposure to any media	No	2647(68.6)	1212(31.4)	3859
	Yes	3295(61)	2105(39)	5403
Husband's occupation	Agriculturalists	4385(69.5)	1924(30.5)	6309
	Professional	751(50.8)	726(49.2)	1477
	Business	241(53.9)	206(46.1)	447
	Laborer	435(53.8)	374(46.2)	809
	Others	130(59.1)	90(40.9)	220
Total		**5942(64.2)**	**3320(35.8)**	**9262**

A chi-square test was applied to assess heterogeneity in the proportion of women who were married early among the 11 regions. The test yield $X^2=573.229$, df =10, P<0.001. Thus, there is evidence for heterogeneity with respect to age at first marriage across regions.

First, an empty model with random effect and no covariates was examined for the over all probability of early marriage. Second, a multilevel model for random effect and a fixed slope covariate was examined for early marriage.

Multilevel logistic regression model comparison

Before interpreting multilevel models, we compare the three multilevel logistic regression models (nested models) considered. To do so, deviance and AIC were used. The deviance of the empty model with random intercept (deviance= 5774.17) and random intercept and fixed slope model (deviance =5489.789) indicate that the random intercept and fixed coefficient (slope) model is better than the empty model with random intercept. In addition to this the AIC value of the empty model with random intercept (AIC = 11552.34) is larger than that for the random intercept and fixed coefficient model (AIC =11015.8), which implies that random intercept and fixed slope model is better than the empty model with random intercept in predicting early marriage. The deviance of a fixed slope and random intercept (deviance = 5489.789) and random coefficient model (deviance =5475.804) show that random coefficient model is better than the random intercept and fixed slope model.

The AIC value of the random coefficient model (AIC = 11005.61) is smaller than the random intercept and fixed coefficient model (AIC =11015.8) implying that random coefficient model is better compared to the random intercept and fixed slope model in describing early marriage (Table 2). Furthermore, the significant deviance-based chi-square value for random coefficient model indicates that the random coefficient model is better than the multiple logistic regression models in explaining early marriage (Table 2). Finally; a random coefficient multilevel logistic regression model with random effect for early marriage was analyzed.

The Empty Random Intercept Logistic Regression Analysis: The simplest non-trivial specification of the hierarchical linear model is a model in which only the intercept varies between level two units and no predictor (explanatory) variables are entered in the model. That is a random intercept or variance components model that allows the overall probability of early marriage to vary across regions.

The deviance-based Chi-square (X^2= 539.17, p-value<0.001) in table 3, shows the difference in -2*log likelihood between an empty model without random effect and an empty model with random effect and implies that the empty model with random effect is better than the empty model without random effect. Conversely, the variance of the random effect of the region random intercepts (σ_0^2 =0.3077789, p-value=0.0108) reveals that there is a significant difference in early marriage across regions. This implies that multilevel model is more appropriate relative to single level (ordinary) logistic regression model. The intercept (B_0) =0 .5276274 interpreted as the overall mean of early marriage. That is the intercept informs us that the average probability of early marriage everywhere in Ethiopia is exp (0.5276274)/ [1+exp (0.5276274)] = 0.629. The empty model with random effect also helps to calculate the between region variations by the help of intra -class correlation coefficient (ICC). ICC is the correlation between two individuals who are in the same higher level unit. The computed ICC= 0.0861

Table 2: Summary of Multilevel Logistic Regression Model Selection Criteria.

Model Selection Criteria	Empty Model	Random intercept Model	Random coefficient Model
Deviance Based chi-square	539.17	236.77	264.74
P-value	0.00*	0.00*	0.00*
Deviance	5774.17	5489.789	5475.804
AIC	11552.34	11015.8	11005.61

*significant at 5%

Table 3: Results of Empty Random Intercept Logistic Regression Model Analysis.

Fixed Part	Coef.	S.E	Z-Value	P-value	[95% CI]
B_0 =intercept	.5276274	.1688939	3.12	.002*	0.1966018 0.858653
Random Part	Estimate	S.E	Z-value	p-value	
Level two variance, $\sigma_0^2 = var\left(u_{0j}\right)$	.3077789	.1341304	2.295	.0108*	
Deviance based Chi-square	539.17			.000*	

*significant at5%

shows 8.6% of the variation in early marriage can be explained by grouping the women in regions (higher level units). The remaining 100-8.6%=91.4% of the variation of in early marriage is explained within region-lower level units.

The Random Intercept Model: Here we analyze a model with all lower level explanatory variables fixed .That is, the random intercept varies across regions, but women level explanatory variables are fixed across regions.

According to the result of the random intercept with fixed slope model, the fixed part showed that, religion (Orthodox and Muslim), women's education level, husband's education level, Place of resident, exposure to any media, respondents work status and wealth index were found to be significant determinants of variation in early marriage in all regions with respect to the corresponding reference categories (Table 4). The estimated coefficients and odds ratio have similar interpretation like in ordinary logistic regression [14]. Random part has additional information which is discussed below.

The random part of random intercept and fixed slope model shows that the intercept variance of the random effect is 0.1609268 whereas the variance of the intercept for the empty multilevel model is 0.3077789. The variance of random effect of the intercept and fixed slope model decreased compared to random effect of the intercept empty model. The reduction of the random effects of the intercept variance is due to the inclusion of fixed explanatory variables. That is, taking into account the fixed independent variables can provide extra predictive value on early marriage in each region. The significance of the random effect intercept variance indicates that there is a significant regional random effect variation on early marriage among women (Table 4). This implies that there is still unexplained variation on early marriage across regions.

Random Coefficients model: So far, we have allowed the

Table 4: Results of Random Intercept and Fixed Coefficient Model Analysis of Early Marriage among Married Women in the age Group 15-49.

Fixed effects Covariate		$\hat{\beta}$	S.E	Z-value	P-value	Exp $(\hat{\beta})$	95% C.I. for Exp $(\hat{\beta})$	
							Lower	Upper
Religion	Others(Ref.)							
	Protestant	.1586971	.1463196	1.08	.278	1.171983	0.8797795	1.561237
	Muslim	.3242657	.1506163	2.15	.031*	1.383015	1.02949	1.85794
	Orthodox	.5248814	.1533389	3.42	.0001*	1.690258	1.2515	2.28284
Women's Education level	Higher(Ref.							
	Secondary	.7944596	.1905018	4.17	.000*	2.213245	1.523611	3.215029
	Primary	1.484505	.1754228	8.52	.000*	4.412781	3.13624	6.208912
	None	1.6401262	.1764895	9.07	.000*	4.959285	3.509061	7.008857
Husband's education level	Higher(Ref.)							
	Secondary	.5658798	.1282552	4.41	.000*	1.760996	1.369312	2.264721
	Primary	.7847019	.1122443	6.99	.000*	2.191753	1.758932	2.731079
	None	.7454771	.1137666	6.55	.000*	2.107447	1.686236	2.633873
Place of resident	Urban(Ref.)							
	Rural	.2316703	.0801834	2.89	.004*	1.260704	1.07736	1.475249
exposure to any media	Yes(Ref.)							
	No	.3096615	.0474757	6.52	.000*	1.362964	1.241861	1.495876
Respondents work status	Working(Ref.							
	Not working	.1764748	.0514203	3.43	.001*	1.193004	1.078631	1.319505
Wealth index	Richest(Ref.)							
	Richer	.343268	.0893373	3.84	.000*	1.409547	1.183138	1.679281
	Middle	.2060601	.0927651	2.22	.026*	1.228827	1.02454	1.473848
	Poorer	.4247346	.089815	4.73	.000*	1.529184	1.282358	1.82352
	Poorest	.1728368	.0849561	2.03	.042*	1.188672	1.006346	1.404031
Constant		-3.293785	.2857016	-11.53	.000*			
Random effect		Coefficient	Z-value	S.E	P-value	95% Cof. Interval		
Level two variance, $\sigma_0^2 = var(u_{0j})$		0.1609268	2.24123	.071832	.012*	0.259024	0.6212798	
Deviance based Chi-square		236.77			.000*			
Deviance		5489.789						
AIC		11015.58						

*significant at 5%., OR: Odd Ratio

probability of early marriage to vary across regions, assuming that the effects of the explanatory variables are the same for each region. However, effect of religion of women, women's education level and husband's education level on early marriage might vary across regions. So, in the random coefficient model, we need to introduce a random coefficient of: religion, and women's and husband's education level to vary randomly across regions.

The results of fixed part of the random coefficient model showed, women's education level, husband's education level, Place of resident, exposure to any media, respondents work status and wealth index are significant determinants of variation in early marriage in all regions with respect to the corresponding categories (Table 5).

Table 5 shows that the value of $var(u_{0j})$, $var(u_{1j})$, $var(u_{2j})$ and $var(u_{3j})$ are the estimated variance of intercept, slope of religion, slope of husband's and women's education level respectively. These estimated variances, intercept and slope of women's education are significant at 10% level of significant suggesting that intercept and slope of women's education level

vary significantly. So, there is a significant variation in the effect of women's education level across regions in Ethiopia.

The variance component corresponding to the slope of women's education is .0559662, which is also relatively large with respect to its standard error .0349521.Thus; this suggests that the effect of women's education may be justified in constructing the effect to be random. The random effect women who have no education as log-odds of early marriage in region j is estimated as 1.411915+ $\bar{U}_j$, and the between-regions variance in the effect of women's education is estimated as .0559662. And this result showed that there is a significant women's education effect variation across regions in explaining early marriage.

The negative covariance estimate of (σ_{03} =-.284159) between intercept and slopes of women's education level, suggest that regions with a high intercept (above-average) tends to have a flatter-than-average slope

In general, Positive correlation between intercepts and slopes implies that regions with higher intercepts tend to

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Table 5: Results of Random Coefficient Logistic Regression Analysis for Early Marriage among Married Women in the Age Groups 15-49.

Fixed effects Covariate		$\hat{\beta}$	S.E	Z-value	P-value	95% C.I for $\hat{\beta}$	
						Lower	Upper
Religion	Others(Ref.)						
	Protestant	.0987635	.1743046	.57	.571	-.2428673	.4403942
	Muslim	.2801728	.2378411	1.18	.159	-.1859871	.7463326
	Orthodox	.4207648	.2990076	1.41	.159	-.1652793	1.006809
Women's Education level	Higher(Ref.)						
	Secondary	.703199	.2082563	3.38	.0001*	.2950242	1.1111374
	Primary	1.298988	.2319892	5.60	.000*	.8442975	1.753678
	None	1.411915	.2835911	4.98	.000*	.856087	1.967744
Husband's education level	Higher(Ref.)						
	Secondary	.555529	.1309934	4.24	.000*	.2987867	.8122713
	Primary	.7842805	.1200774	6.53	.000*	.5489332	1.019628
	None	.7466333	.1295012	5.77	.000*	.4928156	1.000451
Place of resident	Urban(Ref.)						
	Rural	.2468426	.0810061	3.05	.02*	.0880737	.4056116
exposure to any media	Yes(Ref.)						
	No	.3048058	.0476596	6.40	.000*	.2113947	.3982169
Respondents work status	Working(Ref.						
	Not working	.1816444	.0517451	3.51	.012*	.0802258	.2830629
Wealth index	Richest(Ref.)						
	Richer	.3516724	.089523	3.93	.000*	.1762105	.5271343
	Middle	.2142407	.0933071	2.3	.022*	.0313622	.3971192
	Poorer	.4387986	.0904075	4.85	.000*	.2616031	.6159942
	Poorest	.2038199	.0858708	2.37	.018	.0355162	.3721236
Constant		-3.06946	.38915	-7.88	.000*	-3.828666	-2.303266
Random effect		Coefficient	S.E	Z-value	P-value		
$\sigma_0^2 = var\left(u_{0j}\right)$		1.582934	1.074897	1.48	0.069**		
$\sigma_1^2 = var\left(u_{1j}\right)$		.057893	.0458878	1.26	.104		
$\sigma_2^2 = var\left(u_{2j}\right)$		.0043261	.005264	.822	.2055		
$\sigma_3^2 = var\left(u_{3j}\right)$		.0559662	.0349521	1.62	.052**		
$\sigma_{01} = Cov(U_{0j}, U_{1j}$		-.2409733	.201984	-1.19	.117		
$\sigma_{02} = Cov(U_{0j}, U_{2j})$		.0181126	.0572779	.315	.376		
$\sigma_{03} = Cov(U_{0j}, U_{3j}$		-.2841597	.1783573	-1.60	.055**		
$\sigma_{12} = Cov(U_{1j}, U_{2j}$		-.0079277	.0117756	-.068	.473		
$\sigma_{13} = Cov(U_{1j}, U_{3j}$		.0342048	.0301287	1.133	.12861		
$\sigma_{23} = Cov(U_{2j}, U_{3j}$		.0007129	.0104619	.046	.482		
Deviance based Chi-square		264.74			.000*		
Model selection criteria							
Deviance			5475.804				
AIC			11005.61				

*significant at 5%** significant at 10%

have on average higher slopes and 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.

Discussion of the Result

This study was intended to identify socio-economic and demographic determinants of early marriage among women based on Ethiopian Demographic and Health Survey (EDHS, 2011) data. Accordingly, descriptive analysis, and multilevel logistic regression analysis were used. The results which are obtained are discussed as follows. The descriptive analysis of the study revealed that the prevalence of early marriage was 64.2 %. The proportion of early marriage of women varied from one region to the other in Ethiopia. The highest proportion (85.5%) of early marriage women was observed in Amahara followed by Benshangul-Gumez (72.3%) and the least proportion (37.4%) of early marriage was observed in Addis Ababa, followed by Dire Dawa (47.2%). Hence, there appears to be some variation in the proportion of early marriage among women in different regions of Ethiopia (Table 1). This could be due to the desire of the family to keep one's good name and social esteem and (mostly of fathers), to create bonds or relationships with families of their choice. The other possible reason might be Tradition and cultural values of the region. Therefore region has statistically significant effect on early marriage. This result is consistent with [15].

In the multilevel analysis, women are considered as nested within the various regions in Ethiopia. Three multilevel models: empty model, random intercept and random slope or random coefficient model were fitted in order to explain regional differences in early marriage. Before the analysis of data using the multilevel approach, we need to test the heterogeneity age at first marriage among women across eleven regions of Ethiopia. A chi-square test was applied to assess heterogeneity in the proportion of women who were married early among the 11 regions. Thus, there is evidence for heterogeneity with respect to age at first marriage across regions. Such heterogeneity is a requirement in the multilevel analysis. Following this, three multilevel logistic regression models were fitted for the national sample as a whole

The multilevel logistic regression model provided interesting relationships that would not be evident from a simple; single-level analysis. We showed that there is a significant variation of early marriage between regions. This may suggest differences in lifestyle, culture, ethnic or environmental determinants between different regions. Because of these potential cultural, socioeconomic and environmental differences, early marriage exhibits a significant variation among regions of Ethiopia. In the empty with random intercept model and random intercept and fixed slope models, the overall variance of the constant term was found to be statistically significant, which indicates the existence of differences in early marriage among married women across regions.

According to the result of the random intercept with fixed slope model, the fixed part showed that, religion (Orthodox and Muslim), women's education level, husband's education level, Place of resident, exposure to any media, respondents work status and wealth index were found to be significant determinants of variation in early marriage in all regions with respect to the corresponding reference categories (Table 4)

were as occupation of husband's and number of siblings are not significant

Women who had no education, primary and secondary were more likely to be married early (OR=4.95, 4.41 and 2.21) respectively compared to women with higher education level controlling for other variables in the model (Table4). The significance level for all education categories were significant and thus risk of getting early marriage increased as the level of education decreased. These results provide empirical evidence that a woman's educational level is an important determinant of early marriage in Ethiopia. Less or no education leads to increased early marriage and therefore lower levels of education are associated with a higher probability of early marriage. The results obtained clearly showed that education has a statistically significant and strong delaying effect on early marriage. A lower risk of getting married early among educated women may be due to waiting time for schooling. This finding is supported by previous studies [16]. Husband's education level is also showed significant effect on early marriage.

The findings of this study also show that women who lived in rural area is more likely to get early marriage than women who lived in urban. This could be rural areas tend to have institutional and normative structures such as the kinship and extended family that promote early marriage and it also might be People in urban areas need to develop skills, gain resources and achieve maturity to manage an independent household and thus they might be delay marriage. This finding is consistent with other studies [17,18].

Religion of women was also found one of the determinants of early marriage. Married women who were followers of Coptic Orthodox religion were more likely to exercise early marriage than those who were followers of religions other than Protestant and Muslim. Similarly Muslim married women were more likely toget early marriage compared to those religions other than Coptic Orthodox and Protestant. This is in agreement with the findings in other studies [15,16].

Household economic status (wealth index) is one of the most important determinants of early marriage among married women in Ethiopia. According to our findings, as compared with women residing in richest economic status households (wealth index), the risks of being early marriage in richer and poorer households were highly significant. This could be because of early marriage as a way to improve the economic status of the family, arguing that poverty forces families to marry their daughters at a young age. This is in agreement with the findings in other studies [2,19]. Access to mass media is one of the important effective factors that influence early marriage. The result indicated that women who do not exposure to any mass media via radio, TV or newspapers/magazine have more likely to get early marriage compared to exposure to any mass media. This finding is consistent with other studies [19].

The random coefficient model showed that the random effects of women's education level vary across regions in explaining early marriage. Further this model implies that there exist considerable differences in early marriage among

regions and a model with a random coefficient is more appropriate to explain the regional variation than a model with fixed coefficients or empty model with random effects

Conclusions

The descriptive analysis of the study revealed that the prevalence of early marriage was 64.2 %.The study revealed that socio-economic and demographic variables have significant effect on early marriage among women in Ethiopia. According to the result of the random intercept with fixed slope model, the fixed part showed that, religion (Orthodox and Muslim), women's education level, husband's education level, Place of resident, exposure to any media, respondents work status and wealth index were found to be significant determinants of variation in early marriage in all regions with respect to the corresponding reference categories.

In the multilevel analysis, the random parts of the intercept and the coefficients provided additional information. In the empty with random intercept model and random intercept and fixed slope models, the overall variance of the constant term was found to be statistically significant, which indicates the existence of differences in early marriage among married women across regions. The random coefficient model showed that the random effects of women's education level vary across regions in explaining early marriage. Further this model implies that there exist considerable differences in early marriage across regions and a model with a random coefficient is more appropriate to explain the regional variation than a model with fixed coefficients or empty model with random effects.

Recommendations

In light of the research findings, the following recommendations are forwarded. As there is variation in the status of early marriage in regional states of Ethiopia; it is recommended that regions have to take policies and programs that address the problem taking into account the context of the region. It is also crucial to continue improving girls and young women access to education in the country, as this is important avenue for increasing the women's age at first marriage. Similarly, it is advisable to target young women, particularly those with no or little education, for providing information on reproductive health and basic life skills to enable them avoid early sexual activity and ultimately early marriage. These should include primary school girls.

Limitation of the study

This study includes only ever-married women. This may bias downward age at first marriage because women in the older group who had not married were not included. Limited literature on Ethiopia related to the subject and the problem of missing values and non-response rate and inconsistence answers for some variables were the main root limitations of this study. Finally it is quantitative research.

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