Research Article

Women education in Ethiopia

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Background

Education is a vehicle for national economic development equally as for individual advancement. Historically, girls were denied opportunities for schooling in most of the regions and societies of Ethiopia. So this study geared towards the factors of women's education level in Ethiopia.

Methods

Secondary data on women's data sets were obtained from the 2016 Ethiopia Demographic and Health Survey. A population-based cross-sectional study design was used for the survey. The sampling technique used for the survey was the two-stage sampling technique, which is stratified in the first stage and equal probability systematic selection technique in the second stage. An ordinal logistic regression model was fitted to identify the determinants of women education in Ethiopia.

Results

Among the random sample of 17137 women, the majority 7647(44.62%) were illiterate. This is evidence that most the women are still under the darkness of illiteracy and having meager participation in higher education. The odds ratios for women's age at first birth, women's age at marriage, women from rural areas, families wealth index: poorer, middle, richer, the richest, religion: Catholic, Muslim, and Protestant religions were given as 1.022 (p value: <0.0001), 1.02 (p value: <0.0001), 0.121 (p value: <0.0001), 1.492 (p value:=0.0235), 1.971 (p value: <0.0001), 3.072 (p value: <0.0001), 4.582(p value: <0.0001), 0.185 (p value: =0.0074), 0.762 (p value: =0.0175), and 0.75 (p value: =0.0444) respectively, and they are statistically significant predictors of education level among women in Ethiopia.

Conclusion

The results of this study showed that most of the women were illiterate due to different reasons. Thus, the federal government, the Ministry of Education, and the Regional Education Bureaus must enforce the legal age of marriage and increase the number of schools and other infrastructure in rural areas.

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Introduction

Education has been used as a vehicle for national economic development equally as for individual advancement. The witness from third world countries shows an in-depth link between women's education and social and economic development and between the sizes of the gender gap in education and national development [1]. Education would have a bearing on people's lives through several channels. It affects access to data, knowledge, and new concepts. It enhances the overall potency, market opportunities, and position. It collectively changes attitudes and behaviors, among the various things, conveyance relating to openness to new ideas and experiences, increasing independence from ancient authority, and questioning of passivity and determinism. These effects apply to every sex. However, men were exposed to new ideas through their wide contacts with the globe outside the house and native community, equally as through formal schooling. In distinction, many women within the developing world have few contacts with the outside world; and for them, formal schooling remains the primary channel for the transmission of the latest concepts [2].

Through the second half of the 20th century, countries around the globe struggled to strike a balance between women's participation in the private sphere, notably the family, and in public institutions, such as the economy, education, and the polity. The incorporation of women into public institutions, particularly the labor market, has been viewed as a key strategy for establishing parity between men and women in adult social and political life [3].

The Program of Action adopted at the International Conference on Population and Development (ICPD), held in Cairo, Egypt, in September 1994, reaffirms everyone's right to education and gives special attention to women and the girl child. Terming the education of the illiterate as 'one of the prerequisites for development. The Program recognizes education as a factor for sustainable development in the empowerment of women and gives paramount importance to the elimination of illiteracy among women. It also urges countries to take steps to keep girls and adolescents in school, so as to close the gender gap in primary and secondary school education by the year 2005 [4].

Formal "western-style" education was introduced to Ethiopia virtually a century a gone. At that point solely a few local students predominantly boys received formal education [5]. The newest Education

Statistics of the Ethiopian Ministry of Education shows that in the 2007-08 academic year, the enrolment share of female students in high school was 39.35%, and it absolutely was solely 32.52% within the Preparatory level [6]. In the same document, the annual growth rate of female students' enrolment compared to the previous year shows a considerable trend; and therefore the figures are 20.7 for girls compared to 15.6 for boys in high school level and 25.4 and 17.2 for girls and boys respectively in Preparatory level. Traditionally, girls were denied opportunities for schooling in most of the regions and societies within the country. Their denial of education goes back into the traditional schooling systems. In ancient Ethiopia, the Orthodox Church and Mosques were major institutions chargeable for the discrimination of females in education [7]. Female learning is greatly affected by the attitudes, values, and actions emanating from home, schools, and communities, however, in fact the impact varies in keeping with female stages of development and their amount of contact with those social settings [8]. The family's socio-economic status influences the daughter's education directly through monetary and ethical support for schooling and indirectly through many variables that embrace the daughter's physical, cognitive and psychological development as well as her own motivation, aspiration, and expectations. Additionally, girls and women from middle-income and upper-income families are more likely than those from low-income families to enter school and progress all the way to the university level [9]. Progress towards universal education is on the march around the world by the year 2015 set by over 160 countries as one of the Millennium Development Goals (MDG) at the Millennium Summit in September 2000. Already, the pledge to eliminate gender inequality in primary and secondary education by 2005 was incomprehensible in concerning seventy countries. The goal to boost adult acquisition rates remains elusive [10]. Many qualitative and descriptive studies were conducted at different components of the globe on women's education and management [11][12][13][14][15], however, these don't reach a standardized statistical model and inferential analysis on the level of women's education particularly in Ethiopia. Hence with relevancy to those terms of literature, this study geared towards determinants of women's education level in Ethiopia using EDHS 2016 data.

Methods

Data source

This study uses secondary data set from the 2016 Ethiopia Demographic and Health Survey (EDHS) which was the fourth demographic and health survey. From January 18, 2016, to June 27, 2016, the survey used a

population-based cross-sectional study design in which women were interviewed for information on their education history. Each one was among women aged 15-49 and each one among men aged 15-59, who were either permanent residents of the chosen households or visitors who stayed the night before the survey could be interviewed. The survey was enforced by the Central Statistical Agency (CSA) with support from the Ministry of Health. This was the fourth Demographic and Health Survey (DHS) conducted in Ethiopia, under the worldwide measure of DHS project, a USAID-funded project providing support and technical help within the implementation of population and health surveys in countries worldwide.

Sampling design

The sampling frame used for EDHS 2016 was the Population and Housing Census (PHC) conducted in 2007 by the Central Statistical Agency (CSA, 2008). The census frame was a complete list of 84,915 enumeration areas (EAs) created for the 2007 PHC. An EA is a geographic area covering an average of 181 households. Administratively, Ethiopia is divided into 9 nation-states and 2 administrative cities. Every region is sub-divided into zones, every zone into Woredas, every woreda into cities, and every city into kebeles. The sampling technique used for the survey was the two-stage sampling technique, which is stratified in the first stage and equal probability systematic selection technique in the second stage. Stratification was achieved by separating every region into urban and rural areas. In total, 21 sampling strata were created as a result of the Addis Ababa region is entirely urban. Samples of EAs were selected independently in every stratum in 2 stages. Among the primary stage 645 selected EAs, 202 were urban and 443 were rural areas and in the second stage of selection, a fixed number of 28 households per cluster were selected with an equal probability systematic selection from the newly created household listing. All women age 15-49 and all men age 15-59, who were either permanent residents of the selected households or visitors, who stayed in the household the night before the survey, were eligible to be interviewed.

Variables in the study

The response variable of this study was the education level of women in Ethiopia. According to [16] education level is ordered as no education, primary education, secondary education, and higher education. The selection of explanatory variables was theoretically driven that was supported by prior researches. Accordingly, the women's age at first marriage, frequency of listening to radio, frequency of reading newspapers and magazines, frequency of watching television, childhood place of residence,

family's Wealth index, Religion, and Women's age at first birth were potential predictors of women's education level. Secondary data was managed with SPSS-26 and analyzed with SAS- 9.4. The model selection was made using LRT for nested, AIC, and BIC for non-nested models. Variable selection was made by purposeful method while a univariable analysis was made between a response variable and each predictors separately at 25% level, then a multivariable analysis was performed at 5% level between a response variable and all significant variables in the univariable analysis.

Ethical statement

This study is a secondary data analysis of EDHS, which is publicly available. The original DHS data was collected in conformity with international and national ethical guidelines. Ethical clearance was provided by the Institutional Review Board of International Classification of Functioning (ICF).

Statistical analysis

Ordinal logistic regression

Ordinal logistic regression models were developed to model the dependence of a polychromous ordinal response on a set of predictors which can be factors or covariates. The design of the ordinal logistic regression model was based on established methodology [17]. There are many variations of logistic models used for predicting an ordinal response variable Y. All of them have the advantage that they do not assume a spacing between levels of the response variable Y. In other words, the same regression coefficients and P -values result from an analysis of a response variable having rank based levels. The most commonly used logistic regression model for ordinal response is the ordinal logistic model and later called the proportional odds model [17]. The proportional odds model is best stated as follows, for a response variable having levels 0, 1, 2,..., k:.

$$Pr\left[Y \leq j|X\right] = \frac{1}{1 + exp[-(\theta j + X\beta)]'}$$

Where j =1, 2... K.

But the proportional odds model applies ordered odds logit transformation to the response probabilities $\pi_1 + \pi_2 + \pi_3 + \ldots + \pi_j = \gamma_j$ as:

$$\text{Logit}(\gamma_j) = log(\frac{\gamma_j}{1 - \gamma_j}) = \theta_j + X_i'\beta$$

called it the proportional odds model

instead of applying the ordered logit transformation to the response probabilities.

Exponentiating the above equation we find that the odds of a response in category j or below, are: $\frac{\gamma_j}{1-\gamma_j} = \lambda_j exp(X_i'\beta)$ where $\lambda_j = \exp(\theta_j)$

From the above model we can find the cumulative probabilities as:

$$\gamma_j = \frac{\lambda_j exp\left(X_i'\beta\right)}{1 - \lambda_j exp\left(X_i'\beta\right)}$$

There is an implicit assumption in the proportional odds model that the regression coefficients (β) are independent of j, λ_j is defined as the baseline odds of response in category j or below when X = 0. The effect of the covariates, X is to raise or lower the odds of response in category j or below by the factor $exp(X_i'\beta)$ and the effect is a proportionate change in the odds of $Y_{i \leq j}$ for all response categories j. That is, if a certain combination of covariate values doubles the odds of being in category 1, it also doubles the odds of being in category 2 or below, or in any category or below. Hence the name proportional odds.

Results

Descriptive statistics

The education level of randomly selected women in the country was classified as no education, primary education, secondary education, and higher education based on EDHS 2016 report. Accordingly, among the random sample of 17137 women, 7647(44.62%) belonged to no education, which is followed by 5673 (33.10%), 2458 (14.34%) and 1319(7.93%) were in primary, secondary, and higher education respectively. As we come across the education levels the percentage of women enrollment decreases, accordingly, where most of women were subjected to being illiterate (Figure 1).

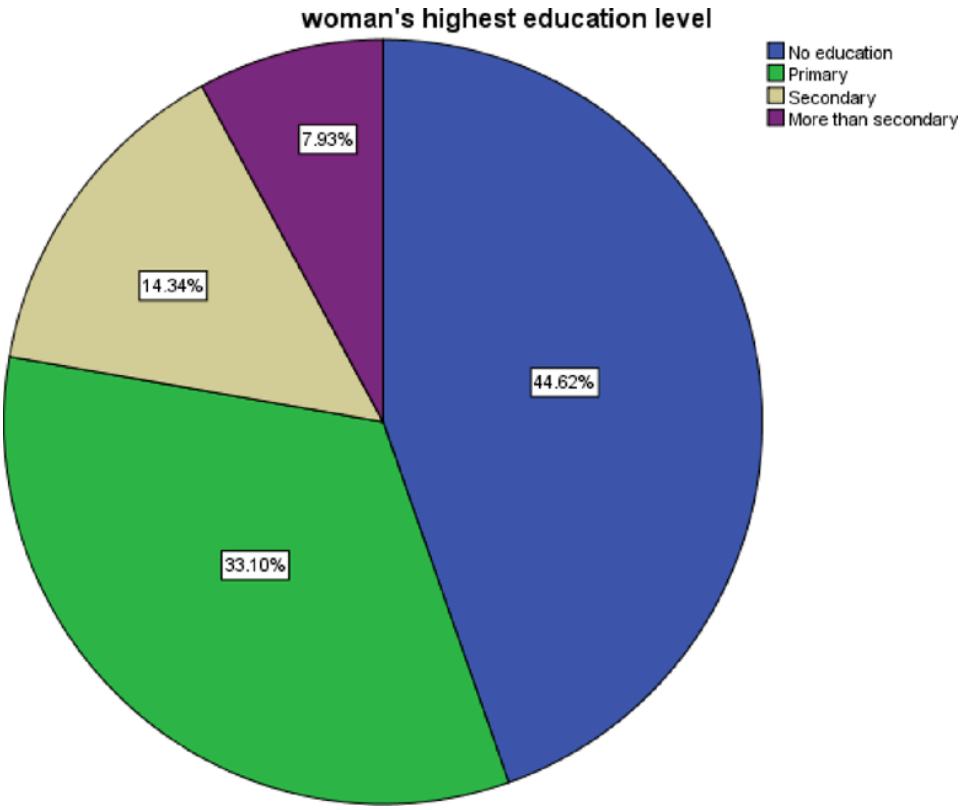

Figure 1. Education level of women.

Women Education Level and its Socio-Demographic and Economic Features

The majority, 65.6% of women have emerged from rural areas of Ethiopia. The majority of these sample women were illiterate (44.62%), Orthodox (41.7%), and poorest income level (26. 6%) relative to other corresponding labels of a factor. Moreover, statistically significant chi-square statistic implies that there is a significant association between the level of education and the corresponding categorical predictor variables in the study (Table 1).

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variable	categories	Percent	χ^2 - value (P-value)
Place of residence	Urban	34.4	1670.841(<.0001)
	Rural	65.6	
Religion	Orthodox	41.7	3437.388 (<.0001)
	Catholic	0.6	
	Protestant	17.4	
	Muslim	39	
	Traditional	0.7	
	Others	0.5	
Wealth index	poorest	26.6	575.120(<.0001)
	Poorer	16.6	
	middle	17.9	
	Richer	17.6	
	Richest	21.3	

Table 1. Descriptive Statistics

Model selection

The null model was the model fitted without any factor or covariate whereas the full model was the model fitted with all the predictors considered for the model. Therefore, based on the nested nature of these two models the full model was a better fit to the data based on a significant likelihood ratio test (Table 2).

Model	AIC	BIC	-2 Log L	LRT
Null model	4115.774	4131.915	4109.774	
Full model	3443.582	3540.427	3407.582	702.1918(p <0.0001)

Table 2. Model selection

Ordinal logistic regression model

The final ordinal logistic regression model was fitted through all the significant predictors in the univariable analysis. Since all the predictors were significant in the univariable analysis at 25% level, multivariable analysis was made by using all the predictors in the study. Accordingly, Table-3 displays the results of the final model with the appropriate fixed effect estimates. Among the predictors in the final model age at first marriage, residence, family's wealth index, women's age at first birth, and religion of women were the major predictors of education level among women in Ethiopia. Moreover, the score test for the proportional odds assumption is insignificant at a 5% level of significance, indicating that the data meet the proportional odds assumption. To confirm the conclusion about the proportional odds model assumption, single score tests were undertaken for each covariate. The test findings show that, all factors were found to be insignificant, indicating that the proportional odds assumption was met (Table 3).

parameter	category	Estimate (Exp (Est))	SE	Wald χ^2	Pr > ChiSq	Score test	
Intercept	No educ	-1.5026(0.222)	0.2781	29.1998	<.0001		
Intercept	Primary	-3.5901(0.028)	0.2918	151.4215	<.0001		
Intercept	Secondary	-4.9693(0.007)	0.3023	270.2584	<.0001		
Age at first birth		0.0219(1.022)	0.0012	333.0625	<.0001	0.395	
Radio		0.0325(1.033)	0.0653	0.2473	0.6190	0.251	
Newspaper		0.1041(1.11)	0.0886	1.3815	0.2398	0.652	
Television		-0.1104(0.895)	0.0753	2.1495	0.1426	0.496	
Age at first marriage		0.0187(1.02)	0.0012	242.8402	<.0001	0.429	
Wealth (ref= poorest)	poorer	0.4003(1.492)	0.1767	5.1302	0.0235	0.066	
	Middle	0.6786(1.971)	0.1689	16.1456	<.0001	0.096	
	Richer	1.1223(3.072)	0.1671	45.0940	<.0001	0.067	
	Richest	1.5221(4.582)	0.1612	89.1823	<.0001	0.071	
Residence (ref= urban)	Rural	-2.1123(0.121)	0.1197	311.2825	<.0001	0.947	
Religion (ref = Orthodox)	Catholic	-1.6869(0.185)	0.6296	7.1791	0.0074	0.794	
	Muslin	-0.2720(0.762)	0.1145	5.6429	0.0175	0.550	
	Other	-0.1865(0.830)	0.5817	0.1029	0.7484	0.976	
	Protestant	-0.2881(0.750)	0.1433	4.0423	0.0444	0.810	
	Traditional	0.8181(2.27)	0.6350	1.6603	0.1976	0.802	

Table 3. Final ordinal logistic regression model

Test of parallel lines

The proportional odds assumption is commonly called test of parallel lines because the null hypothesis states that the slope coefficients in the model are the same across response categories (and lines of the

same slope are parallel). Since the ordered logit model estimates one equation over all levels of the response variable, the test for proportional odds tests the validity of one-equation model. If we were to reject the null hypothesis based on the significance of the Chi-Square statistic, we would conclude that ordered logit coefficients are not equal across the levels of the outcome, if we fail to reject the null hypothesis, we conclude that the assumption holds. For our model, the proportional odds assumption appears to have held because the significance of Chi-Square statistic is 0.687 > 0.05 (Table 4).

	-2log likelihood	**Chi-square**	**Pr > ChiSq**
Null Hypothesis	3317.852		
General	3310. 446	7.406	0.687

Table 4. Test of parallel lines

Discussion

The labeled Intercept for no education was -1.5026, this implies that the estimated log odds of falling into the category of no education versus all other categories of education while all the predictors are zero was -1.5026. Thus the estimated odds of no education, when all the covariates are at the baseline and all the factors at the reference level was exp (-1.5026)= 0.222. The labeled Intercept for primary education was -3.5901, this implies the estimated log odds of falling into primary education versus secondary and higher education while all the predictors are zero was -3.5901. Thus the estimated odds of primary education, when all the covariates are at the baseline and all the factors at the reference level was exp (-3.5901)= 0.028. The labeled Intercept for secondary education was -4.9693, this implies the estimated log odds of falling into secondary education versus higher education while all the predictors are zero was -4.9693. Thus the estimated odds of secondary education, when all the covariates are at the baseline and all the factors at the reference level was exp (-4.9693)= 0.007.

The estimated slope of women age at first birth was 0.0219 with the estimated odds ratio of exp (0.0219) = 1.022(P value <.0001) indicates that early child bearing of women significantly hinders their education

level. More specifically, as women age at first birth increased by one year the odds of women education being one level higher increased by about 2.2% keeping all other variables constant. The result was consistent with [18][19][20].

The estimated slope of women age at first marriage was 0.0187 with the estimated odds ratio of exp (0.0187) = 1.02 (P value <.0001) indicates that, there is the positive relation between women age at first marriage and education level. More specifically, as women age at first marriage increased by one year the odds of women education being one level higher increased by about 2.0 % keeping all other variables constant. The result is coherent with [21][22][23][24].

The estimated slope for education level of women from rural area was -2.1123 with the estimated odds ratio of exp (-2.1123) = 0.121(P value <.0001), indicates that women from rural areas were less likely to get education as compared with urban residents. More specifically, the odds education level among women who were rural residents was 12.1% less than that of urban residents, keeping all other variables constant. The result is coherent with [24][25][26][27]. Moreover, the estimated slope for education level among women within the poorer, middle, richer and richest families with the corresponding estimated odds ratio was 0.4003(1.492), 0.6786(1.971), 1.1223(3.072), 1.5221(4.582) respectively, indicates that women from low income families were less likely than those with middle and high-income families to enter school. Specifically, the odds of women education among from poorer, middle, richer, and the richest families was 1.492, 1.971, 3.072, and 4.582 respectively times the odds of women education among women from the poorest families. The result is consistent with [24][27][28][29][30][31], where women from middle-income and upper-income families are more likely than those from low-income families to enter school and progress all the way to the university level. The estimated slope for education level of catholic, Muslim and protestant women with the corresponding estimated odds ratio was -1.6869(0.185), -0.2720(0.762), and -0.2881(0.750) respectively, indicates that the odds of education level among catholic, Muslim and protestant women was about 0.185, 0.762, and 0.750 respectively times the odds of women's education level among Orthodox women. The result is consistent with [24][32][33][34], where religion has its own effect on the level women education.

Conclusions

This study targeted on the factors of women illiteracy in Ethiopia. The source of the data for this study was the fourth demographic and health survey of Ethiopia. The descriptive part of the data showed that

most of the women were illiterate. Among the predictors within the final ordinal logistic regression model, family's wealth index, childhood place of residence, age at first marriage, women's age at first birth, and religion were significant predictors for women education level in Ethiopia. These findings have valuable policy implications for intervention and program design. Especially for the federal government, the Ministry of Education and Regional Education Bureaus must enforce the legal age of marriage and increase the number of schools and other infrastructure in rural areas.

Abbreviations

CSA: Central Statistical Agency, EDHS: Ethiopian Demographic and Health Survey, Enumeration Area, AIC: Akaike Information Criteria, BIC: Bayesian Information Criteria, EA: LL: Log-Likelihood, LRT: Likelihood Ratio Tests

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Declarations

Availability of data and materials

The data set used for this study was accessed from the Measure DHS website (http://www.measuredhs.com).

Competing interests

The authors declare that there are no competing interests.

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Consent to publish

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Authors' contributions

NMH wrote the proposal, analyzed the data and manuscript writing. KKG involved in drafting the manuscript, revising it critically for important intellectual content. Both authors have given final approval of the version to be published.

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