

Multilevel modeling of unintended current pregnancy: In the case of Ethiopian Demographic and Health Survey, 2016

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Abstract

Background: Unintended pregnancy has been a major public health and reproductive health issue imposing a great adverse consequence on the mother and child. However, estimates of unintended pregnancy through the appropriate model are lacking. This study is aimed at modeling and assessing the extent of variation and factors associated with unintended pregnancy among women in Ethiopia.

Methods: A cross-sectional study was conducted based on 2016 Ethiopian Demographic and Health Survey data related to the reproductive health of 1122 currently pregnant women and a multilevel modeling approach was used.

Results: The proportion of unintended current pregnancies was 20.1%. According to random intercept with a fixed slope model, women who had 1 to 3 living children and those who had 4 and above were more likely to be unintended (OR = 3.54, 95% CI: 1.985–6.332) and (OR = 5.47, 95% CI: 2.67–11.227), respectively, compared to women with no living children. Also, married women were less likely to be unintended (OR = 0.14, 95% CI: 0.065–0.304) compared to unmarried women. In addition, women having work were more likely to be unintended (OR = 1.56, 95% CI: 1.079–2.255). Furthermore, women who intend to use contraceptive methods were less likely to be unintended (OR = 0.54, 95% CI: 0.362–0.796) compared to women who do not intend.

Conclusion: The number of living children, current marital status, the intention of contraceptive use, and respondents' working status were found to have a significant effect. Giving attention to regional variations and intention of contraceptive use is important to reduce unintended current pregnancies in Ethiopia.

Keywords

Pregnancy, women, risk factors, health, mixed methods

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Introduction

Unintended pregnancy is unwanted or mistimed pregnancy. That means it has occurred when no children or no more children were desired or occurred earlier than desired time.^{1,2} Unintended pregnancy has been a major or troubling public health and reproductive health issue imposing a great and appreciable adverse consequence on the mother and child.³ Globally, it is estimated that there are 85 million pregnancies unintended in 2012.⁴

According to World Health Organization, every year around 295,000 women died during and following

pregnancy and childbirth in 2017, which indicates maternal mortality is unacceptably high. The vast majority of these deaths (94%) occurred in low-resource settings, and most

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could have been prevented.⁵ In the world, between 2010 and 2014, 62 unintended pregnancies per 1000 pregnant women were seen with a great discrepancy between developing and developed countries 65 and 45 unintended pregnancies per 1000 pregnant women, respectively.⁶

In sub-Saharan Africa, the overall prevalence of unintended pregnancy is 29% which ranges from 10.8% in Nigeria to 54.5% in Namibia.⁷ Based on the nationwide surveys conducted in Ethiopia (in the years 2000, 2005, and 2011), the percentage of births that were unwanted or unplanned at the time of conception was 37%, 35%, and 28%, respectively. Though there is a decreasing trend in the percentage of unwanted pregnancies in Ethiopia, the prevalence is still very high. Also, the percentage of births that were wanted later remained stable over the years in the range of 19% to 20%.⁸ Different studies conducted in Ethiopia also revealed that the prevalence of unintended pregnancy ranges from 13.7% to 41.5%.^{9,10}

Ethiopians are multi-ethnic and multicultural. These multi-ethnic and multicultural natures of the society may determine their pregnancy intention within women and across regions. Yet the majority of studies conducted in the area considered only the individual levels of variation during the identification and modeling of factors associated with an unintended pregnancy. However, this study attempted to consider both the individual and the variation at the regional level. In general, the study is based on the existing data from the dataset of the Ethiopian Demographic and Health Survey (EDHS) conducted in 2016.¹¹ The report incorporates all the data of regional states including the two urban centers. The study is aimed at modeling and assessing the extent of variations and the factors associated with unintended pregnancy among pregnant women that varies across regions of Ethiopia.

Material and methods

Data source and population

This study was conducted using the 2016 Ethiopian EDHS data. The sampling frame of the 2016 EDHS was a complete list of 84,915 enumeration areas (EAs). In the survey, two stages of stratified sampling technic were used to select a sample. Accordingly, a probability proportional to EA size was used to select a total of 645 EAs in the first stage and equal probability systematic selection was used to select 28 households per cluster in the second stage.¹¹

In the survey, detailed information was collected on issues related to reproductive health (fertility and fertility preference, marriage, awareness, and the use of family planning methods), and adult and childhood morbidity and mortality. Also, information regarding awareness and attitudes toward HIV/AIDS and other important public health issues was collected on 16,650 households of which

15,683 and 12,688 were female and male respondents, respectively. Further information regarding the sampling technique and questionnaire, in general about the survey, can be obtained from the EDHS 2016 report.¹¹

Our analysis was based on the EDHS 2016 women's data (IR data) set, of which a total of 1122 women who were currently pregnant at the time of the survey with complete information were used and the measure was accessed from the demographic and health survey (DHS) program website (<http://www.measuredhs.com>).

Study design

This particular study was a kind of cross-sectional study that was conducted based on data from all currently pregnant women in Ethiopia. A total of 1122 women were reported as they were currently pregnant among 15,683 eligible female respondents invited to participate at the time of the survey.

Measures

The primary outcome of interest (outcome measure) was unintended current pregnancy of reproductive women aged 15 to 49, which was assessed using the question, "Have you wanted your current pregnancy or not?" According to the 2016 EDHS survey questionnaire. From the dataset, a binary outcome was created by categorizing the current pregnancies as unintended and planned (intended) pregnancies. The unintended pregnancy category was created by merging mistimed (wanted later) and unwanted (no more wanted) pregnancies otherwise if the current pregnancy was wanted then, it was considered as the intended pregnancy category.

Participants reporting their current pregnancy intention were asked about outcomes and potential predictors associated with unintended pregnancy at individual and regional level variables, including age, religion, place of residence, education level, current marital status, wealth index, respondent's work status, the number of living children, ever terminated pregnancy, the intension of contraceptive use, and region, were assessed. For this study, participants who have reported their current pregnancy intention about the outcomes and potential predictors associated with unintended pregnancy at individual and regional level variables in the dataset which includes socio-demographic and reproductive health-related variables were considered as independent variables. Generally, age, religion, place of residence, education level, current marital status, wealth index, respondent's work status, the number of living children, ever-terminated pregnancy, the intention of contraceptive use, and region were considered independent measures in the study. The only regional variable in this study was the place of residence. Others were women (individual) level variables.

Statistical analysis

We have used descriptive statistics to describe respondents' characteristics concerning unintended pregnancy to show the distribution of respondents by the key variables with that of unintended pregnancy. Values were expressed as an absolute number (percentages) and a chi-square value for each independent variable to the response variable. After describing the socio-demographic characteristics of the participant with appropriate descriptive statistics and a bivariate association between these characteristics and the intention of pregnancy level, then a multilevel statistical modeling approach was used to investigate the extent of variations and the factors associated with unintended pregnancy among pregnant women at both individual and the regional levels. That means we have generated a multivariable multilevel logistic regression model estimating factors associated with unintended pregnancy by using STATA 14. We conceptualized the analysis in a multilevel structure that comprises individuals (at level 1) nested within the region (at level 2), then we fitted the data using multilevel logistic regression after adjustment of both individual-level and regional-level factors as fixed effects and allowed to be heterogeneous between regions.

The two-level model has specified a binary response (whether or not it was an unintended pregnancy) for a woman living in a particular region in three steps. Firstly, we fitted an empty model, that is, no explanatory variable was included (Model 1). This model represented the total variance in unintended pregnancies between the regions. Secondly, we considered only individual-level factors were included to test the extent of variation to which regional-level differences were explained by individual-level factors (Model 2), and finally, the effects of regional factors on unintended pregnancies were used (Model 3). The results of fixed effects (measures of association) were shown as odds ratios (ORs) with 95% confidence intervals (CIs).

Results

Out of a total of 1122 pregnant women, 225 (20.1%) of them their current pregnancy was unintended whereas 897 (79.1%) were intended pregnancies at the time of the survey. The result in Table 1 also revealed that the proportion of unintended pregnancy differed by place of residence, that is, the prevalence of unintended pregnancy was higher among women who were residing in rural areas (21.6%) than women who reside in urban areas (14.8%).

Regarding region, the proportion of unintended pregnancy varied from one region to the other region in Ethiopia. The highest proportion (34.8%) of unintended pregnancy was observed in Oromia followed by SNNPR (34%) and the least proportion (3.2%) of unintended pregnancy was observed in Somalia, followed by Afar (6.7%).

Hence, there appears to be some variation in the proportion of unintended pregnancy among women in different regions of Ethiopia. The highest percentage of unintended pregnancy was observed in women who have primary education (22.8%) as opposed to the lowest percentage of unintended which was recorded for women who have higher education levels (12.1%).

Also, respondents working status from Table 1 revealed that the highest percentage of women who have worked (25.4%) was observed as unintended as opposed to the lowest percentage of unintended pregnancy recorded from women who have not worked (18.2%). Concerning contraceptive use, the highest percentage of unintended pregnancy was observed for women who intended to use contraceptives (26.2%), and a lower percentage of unintended pregnancy was recorded for women who do not intend to use contraceptives (12.3%).

Before interpreting multilevel models, we compared the three multilevel logistic regression models (nested models) that were considered. To do so, deviance and Akaike information criterion (AIC) were used. So the smallest value of both AIC and deviance would be the best model of all. Therefore, from Table 2, the deviance and AIC values of the random intercept and fixed slope model are less than both the empty model with random intercept and random coefficient model, which implies that the random intercept and fixed slope model is better than the empty model with random intercept and random coefficient models in predicting unintended pregnancy in Ethiopia. The Bayesian information criterion (BIC) is more useful in selecting a correct model while the AIC is more appropriate in finding the best model for predicting future observations.¹²

The deviance-based chi-square ($\chi^2 = 72$, p -value $< .001$) from Table 3, shows the difference in $-2 \times \log$ -likelihood between an empty model without random effect and an empty model with random effect and implies that the empty model with the random effect is better than the empty model without random effect. Conversely, the variance of the random effect of the region random intercepts ($\sigma_0^2 = 0.557$, p -value = .019) reveals that there is a significant difference in unintended pregnancy across regions. This implies that the multilevel model is more appropriate relative to the single-level (ordinary) logistic regression model.

The intercept ($\beta_0 = -1.521$) is interpreted as the overall mean of unintended pregnancy that informs us the average probability of unintended current pregnancy everywhere in Ethiopia is equal to $\exp(-1.521)/[1 + \exp(-1.521)] = 0.545$. The empty model with random effect also helps to calculate the between-region variations with the help of the intra-class correlation coefficient (ICC). $ICC = 0.145$ implies that 14.5% of the variation in unintended pregnancy can be explained by grouping the women in regions (higher-level units). The remaining

Table 1. Socio-demographic characteristics of women aged 15 to 49 (EDHS, 2016).

Variable	Categories	Pregnancy level		Degree of freedom	Chi-square value	p-value
		Unintended (%)	Intended (%)			
Age of women	15-24	63(15.1)	355(84.9)	2	16.34	.000**
	25-34	114(21)	429(79)			
	35-49	48(29.8)	113(70.2)			
Religion	Orthodox	68(23.4)	222(76.6)	3	17.11	.001**
	Protestant	50(27.8)	130(72.8)			
	Muslim	99(15.8)	526(84.2)			
	Others	8(29.6)	19(70.4)			
Place of resident	Urban	34(14.3)	203(85.7)	1	6.11	.013**
	Rural	191(21.6)	694(78.4)			
Number of living children	No child	23(9.4)	221(90.6)	2	25	.000**
	1-3	113(21.1)	422(78.9)			
	4 and above	89(25.9)	254(74.1)			
Region	Tigry	18(22.5)	62(77.5)	10	93.89	.000**
	Affar	8(6.7)	112(93.3)			
	Amahara	27(26.2)	76(73.8)			
	Oromia	54(34.8)	101(65.2)			
	Somali	6(3.2)	179(96.8)			
	Ben-Gumes	10(12.3)	71(87.7)			
	SNNPR	49(34)	95(66)			
	Gambela	15(23.4)	49(76.6)			
	Hararie	14(16.5)	71(83.5)			
	Addis Abeba	8(17)	39(83)			
	Dire Dawa	16(27.6)	42(72.4)			
Women's education level	None	126(19.9)	507(80.1)	3	4.76	.190
	Primary	76(22.8)	257(77.2)			
	Secondary	16(16.3)	82(83.7)			

(continued)

Table 1. Continued.

Variable	Categories	Pregnancy level		Degree of freedom	Chi-square value	p-value
		Unintended (%)	Intended (%)			
	Higher	7(12.1)	51(87.9)			
Contraceptive use	Intends to use	164(26.2)	462(73.8)	1	33.35	.000**
	Don't intend to use	61(12.3)	435(87.7)			
Wealth index	Poorest	61(15)	345(85)	4	16.09	.03**
	Poorer	56(27.5)	148(72.5)			
	Middel	36(17.5)	167(82.5)			
	Rich	39(23.5)	127(76.5)			
	Richest	33(23.1)	110(76.5)			
Respondents work status	Not working	151(18.2)	680(81.8)	1	7.08	.008**
	Working	74(25.4)	217(74.6)			
Current marital status	Not married	18(43.9)	23(56.1)	1	15.09	.000**
	Married	207(19.1)	874(80.9)			
Total		225(20.1)	897(79.1)			

**Significant at 5%.

Table 2. Summary of multilevel logistic regression model selection criteria.

Model selection criteria	Empty model with random intercept	Random intercept model and fixed slope model	Random coefficient model
Deviance	526.187	485.089	489.853
AIC	1056.71	1006.178	1009.255
BIC	1057.76	1116.64	1018.67

AIC: Akaike information criterion; BIC: Bayesian information criterion.

85.5% of the variation of unintended pregnancy is explained within region-lower level units.

From Table 4, the random part of the random intercept and fixed slope model revealed that the intercept variance of the random effect is 0.504, whereas the variance of the intercept for the empty multilevel model is 0.5570 as shown in Table 3. The variance of the random effect of the intercept and fixed slope model decreased compared

to the 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 unintended pregnancy in each region. The significance of the random effect intercept variance ($var(u_{0j}) = 0.504$ with p -value = .0084) indicates that there is a significant regional random effect variation on unintended pregnancy among women, which implies that there is still an unexplained variation in unintended pregnancy across regions.

Discussion

This study was intended to model and assess the prevalence of unintended pregnancy based on EDHS data.¹¹ Accordingly, descriptive analysis and multilevel logistic regression analysis were done and the results were discussed as follows.

The descriptive analysis of the study revealed that the prevalence of unintended pregnancy was 20.1%, which was very close to the findings of different authors.^{13–15} The current prevalence of unintended pregnancy is less

Table 3. Results of unintended pregnancy of empty random intercept model analysis.

Fixed part	Coef.	SE	Z-value	p-value	95% CI
$\beta_0 = \text{intercept}$	-1.521	0.242	-6.28	.001*	(-1.996, -1.046)
Random part	Variance component	SE	Z-value	p-value	
Level-two variance, $\sigma_0^2 = \text{var}(u_{0j})$	0.557	0.279	2.063	.019**	
Deviance-based chi-square 72				.001*	
Deviance	526.187				
AIC	1056.71				
ICC	0.145				

* Significant at 1%, ** Significant at 5%.

SE: standard error; AIC: Akaike information criterion; ICC: intra-class correlation coefficient.

than the reports from different small-scale studies done in different parts of Ethiopia.^{16–18}

In this study, religion is the other most important predictor of unintended pregnancy that varied from one religion to the other in Ethiopia. That is a mother whose religion is Muslim was less likely to report having unintended pregnancy as compared to others. This result is in line with studies done at Gana,¹⁹ Addis Zemen,¹⁵ and Wolayita Sodo.²⁰ Also, this result is in agreement with Teshale and Tesema's findings.²¹

The multilevel regression model provided interesting relationships that would not be evident from a simple single-level analysis. We revealed that there is a significant variation in unintended pregnancy between regions. This may suggest differences in lifestyle, culture, and ethnicity among regions. Because of these potential cultural and socio-demographic differences, unintended pregnancy 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 unintended pregnancy across regions. This is consistent with Habte's finding.¹³

According to the result of the random intercept with the fixed slope model, the fixed part showed that the number of living children (1–3 and 4 and above), current marital status, contraceptive use, and respondent's working status were found to be significant predictors of unintended pregnancy in all regions to the corresponding reference categories (Table 4) whereas wealth index, education level, age, residence, and terminated pregnancy were not statistically significant.

Women who had 1 to 3 and 4 and above the number of living children were more likely to be unintended (OR = 3.54, 95% CI: 1.985–6.332) and (OR = 5.47, 95% CI:

2.668–11.227), respectively, compared to women with no living children holding the effect of other variables constant in the model (Table 4). The significance level for all number of living children categories was significant and thus the risk of getting unintended pregnancy increased as the number of living children increased. These results provide empirical evidence that a woman with a large number of living children is an important factor for unintended pregnancy in Ethiopia. The finding of this study is consistent with that in the literature.²²

The findings of this study also show that married women were less likely to be unintended (OR = 0.14 with p -value = .001) compared to unmarried women or married women who had lower odds of having an unintended pregnancy. This finding was in line with other studies done in Ethiopia.^{10,11,14,21,23,24} This might be because married women may not participate in sexual activity unintentionally which leads the unintended pregnancy to be less.

In addition, respondents' working status was identified as another important determinant of unintended pregnancy in the country. Women having work were more likely to be unintended (OR = 1.56 with p -value = .018) compared to those who have no work. Furthermore, the intention of contraceptive use was also identified as a significant factor for unintended pregnancy, that is, women who intend to use contraceptive methods were less likely to be unintended (OR = 0.54 with p -value = .002) compared to women who do not intend. Women who used contraceptives had lower odds of having an unintended pregnancy compared to their counterparts. The finding of this study was in line with the study in Legabo Woreda, North East Ethiopia,²⁵ but contradicts the study conducted in Ivory Coast.²⁶ This study identified key factors associated with unintended pregnancy, which could be used to design interventions to reduce unintended pregnancy in Ethiopia. However, social desirability bias may have affected the

Table 4. Random Intercept and Fixed Slope Model Analysis of unintended pregnancy.

Fixed effect covariate	Odd ratio	SE	Z-value	p-value	95% CI
Wealth index					
Poorest(ref.)					
Poorer	1.144	0.287	0.54	.591	(0.700, 1.869)
Middle	0.756	0.208	-1.03	.304	(0.443, 1.288)
Richer	0.759	0.213	-0.98	.325	(0.437, 1.316)
Richest	0.800	0.243	-0.73	.465	(0.441, 1.453)
Education level					
No(ref.)					
Primary	1.230	0.247	1.03	.301	(0.831, 1.822)
Secondary	1.015	0.374	0.04	.967	(0.493, 2.089)
Higher	0.638	0.324	-0.89	.376	(0.236, 1.726)
Age					
15-24 (ref.)					
25-34	0.955	0.216	-0.20	.839	(0.613, 1.489)
35 and above	1.245	0.393	0.69	.487	(0.670, 2.311)
Number of living children					
0(ref.)					
1-3	3.545	1.049	4.28	.001**	(1.985, 6.332)
4 and more	5.473	2.006	4.64	.001**	(2.668, 11.227)
Terminate pregnancy					
No(ref.)					
Yes	0.917	0.249	-0.32	.747	(0.542, 1.551)
Marital status					
Not married(ref.)					
Married	0.140	0.055	-4.97	.001**	(0.065, 0.304)
Residence					
Urban(ref.)					

(continued)

Table 4. Continued.

Fixed effect covariate	Odd ratio	SE	Z-value	p-value	95% CI
Rural	1.354	0.383	1.07	.284	(0.778, 2.356)
Contraceptive use					
Do not(ref.)					
Intends	0.537	0.108	−3.10	.002**	(0.362, 0.796)
Working status					
No(ref.)					
Yes	1.560	0.293	2.37	.018**	(1.079, 2.255)
Cons	0.546	0.412	−0.80.	.423	(0.124, 2.403)
Random effect	Variance component	SE	Z-value	p-Value	
Level-two variance, $\sigma_0^2 = \text{var}(u_{0j})$	0.504	0.210	2.39	.008**	
Deviance-based chi-square value	34.89				.001**
Model selection criteria					
Deviance	485.088				
AIC	1006.178				

SE: standard error; AIC: Akaike information criterion; Ref. = reference.

**significant at 5%.

results of this study. Many women in Ethiopia rationalize the pregnancy and report it as intended although the pregnancy was unintended. This may be due to the culture of the society may pose a significant influence on them to use a contraceptive method which is in agreement with another finding.²⁷

Conclusion and future directions

The study revealed that in Ethiopia the majority of women in general report as their pregnancies were unintended. According to the result of the random intercept with the fixed slope model, the fixed part showed that some of the predictors such as the number of living children, current marital status, the intention of contraceptive use, and respondents working status have a significant effect on unintended pregnancy in Ethiopia. Based on the random intercept and fixed slope model, we have concluded the existence of variation in unintended pregnancy differences across regions of Ethiopia. Therefore, regional variations and increasing the intention of contraceptive use should be considered in reducing unintended pregnancy in the country as a whole.

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Availability of data and materials: All result-based data are available within the manuscript and anyone can access the data set online from www.measuredhs.com.

Contributorship: BAW was involved in the initiation of the research concept, analyzing the data, presenting the results, and writing up the draft manuscript. TAG was involved in data analysis and discussions, critical revision, and finalized the manuscript document and approved the final manuscript.


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archive to access EDHS datasets and received permission to access the data files.

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