Determinants of Fertility in Ethiopia: A National Survey in 2017

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Abstract

Objectives: While much research has attempted to identify determinants of fertility in Ethiopia, analysis of structural and individual determinants of fertility at region or zone levels is scarce. This study aims to explore family planning factors by socio-demographic characteristics and identify determinants of fertility at a zonal or regional level.

Methods: A national survey data which investigated reproductive age women (7,979 people) in Ethiopia on six regional states (Amhara, Oromia, SNNPR, Tigray, Somali regions and Addis Ababa) in 2017 were used. We perform several multi-level analyses to identify socio-demographic characteristics of family planning.

Results: Higher education, living in the urban areas and increased age at first marriage are associated with smaller family sizes. Mother's age has a positive significant association with the number of children ever born. Moreover, mothers who had abortion tend to have more children. T number of births varies across region and zone in Ethiopia. Also, there is more variation among regions than zones in the number of children ever born.

Conclusion: This is one of the first national studies in Ethiopia which identified the determinants of fertility at zonal and regional levels. Improving women's education and increasing the age at first marriage should be a policy agenda in terms of family planning. Interventions should be tailored to specify regions or zones to solve the existing problems of fertility.

keywords: *Fertility, Determinants, Family Planning, Ethiopia, Multilevel*

Introduction

Ethiopia, located in the horn of Africa, is the most populous landlocked country in the continent of Africa with an estimated total population of over 100 million, ranking 12th in the world, in 2017 [1]. The country is one of the fasted growing economies in the world, but it is also one of the poorest nation in the world with its GDP per capita 702 US dollars [2] and about 80% of the entire population live in rural areas [3]. The government of Ethiopia implemented national population policy in 1993 to encourage contraceptive. As a result, total contraceptive use had increased from 4% in 1993 to 37% in 2016 [4]. Also, total fertility rate (TFR) has decreased from 5.5 in 2000 to 4.6 children per woman within the last sixteen years. However, only 35.3% women in the reproductive age group used modern family planning (FP) methods with high (22.3%) unmet need for FP, which is among the highest rate in sub-Saharan African countries [5].

Due to its important public health issue, family planning research in Ethiopia has been relatively well documented [5-13]. The studies have found that women's contraceptive knowledge and practice are generally low and FP practice and determinants of fertility are determined by many socio-demographic factors such as women's social status, women's education, women's age at marriage, and gender norm [6, 13-15]. Knowledge, subjective norms, interpersonal communication with spouses were found to be significantly related to women's

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willingness to FP methods [5], which implies the need for addressing multiple determinants at intrapersonal, interpersonal, and probably community and cultural levels.

Fertility in Ethiopia has been high over a long period of time with regional variances. While much research has attempted to identify determinants of fertility in Ethiopia [7, 16-23], analysis of structural and individual determinants of fertility at region or zone levels is scarce. Since 1990s, FP service in Ethiopia has been showing a promising achievement that helps to reduce fertility and lessen the burden of a growing population. Over the past decade, fertility has remained high and FP coverage has stagnated as its low coverage because of a poorly fitting policy design or intervention that understand the structural determinants of fertility [13]. Socio-demographic characteristics include gender inequality, lack of education, cultural and religious barriers, and ethnic differences and these factors such as ethnicity, language, and region are all interconnected [24]. Therefore, it is very important to explore FP factors such as contraceptive methods by socio-demographic characteristics and identify determinants of fertility, especially at a zonal or regional level.

Methods

Data sources and procedure

National-level survey This study was mainly intended on reproductive age (15-49) women (7,979 people) in Ethiopia on six regional states: Amhara, Oromia, SNNPR, Tigray, Somali regions and Addis Ababa city administration. Six out of the nine regions of the country were included in the survey and these regions account for 95% of the total population of the country. The national survey served as formative research that identifies individual and area level determinants of fertility at a regional and zonal level in six regions of Ethiopia. The questionnaire includes background characteristics such as age, education and residence, FP including knowledge, use, and sources of contraceptive methods, birth history and childhood mortality, women's work and background characteristics of husband, infertility, and fertility preferences and so on.

Sampling procedure (Figure 1) The data was collected from December 2016 to January 2017 using stratified cluster sampling methods. First, 30 zones were selected using simple random sampling from the six regions and districts were stratified by place of residence as rural and urban within their respective selected zone. The proposed 3 districts were then allocated proportionally according to their weight to each stratum (rural, urban) in each of the 30 zones. Accordingly, the required 69 districts were selected using simple random sampling from both the rural and urban districts. Then a total of 207 (3 from each district/subcity) enumeration areas, which was taken from the national central statistics agency, was selected. The total sample size (11,968 households, 7,979 women and 3,989 men) was allocated based on probabilities proportional to size to each enumeration area within each district (strata). Finally, households were selected by proximate sampling from each enumeration area with 30-50 interviews conducted per enumeration area.

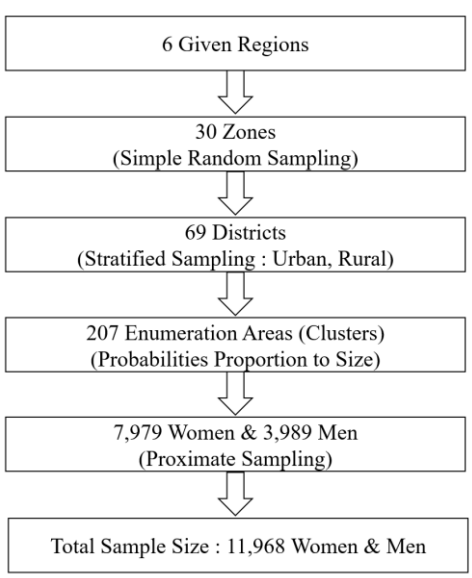

Figure 1. Schematic presentation of the sampling procedure

Data collection procedure and Data collectors Two questionnaires (Women and Men) using smart phones were translated into all languages of the study areas. Research team with different stake holders (professionals from Federal Ministry of

Health, National Population Commission and Central Statistics Agency, investigators, etc.) could control the quality of data and check from where the data was coming using GPS in smart phones. Those procedures were validated by tool validation workshop from research team, training session for enumerators and pre-test for developing final questionnaires and ready for the survey before starting the field work.

There were 80 enumerators (18 for Oromia, 18 for Amhara, 14 for SNNPR, 10 for Tigray, 10 for Addis Ababa and 10 for Somalia) and 23 zonal coordinators (1 for each zone) who have previous experience conducting similar surveys with a BSc (Bachelor of Science) degree or higher levels of educational background. They were selected by research team. The lead investigator took responsibility for training enumerators in the step-by-step procedures. The training was led by the core survey team members and was followed by the 5% field testing of the survey instruments. This was proportionally distributed to the six regions.

Ethics approval and consent to participate This study was approved by the institutional review board of the Mekelle University (ERC 0797/2016); letter of collaboration was solicited from Federal Ministry of Health and from the six regions (Amhara, Tigray, Oromia, Addis Ababa, SNNPR and Somali) health bureaus before the beginning of the actual data collection. All participants gave written informed consent to participate.

Statistical analysis

We explore FP factors by socio-demographic characteristics and perform multi-level analysis (number of births by region & zone). There are two categories of control variables: socio-economic and demographic variables. Socio-economic variables are education, occupation, residence and wealth index, and demographic variables are age at first marriage, age at first pregnancy, age of mother, ethnicity, religion, contraception use, and abortion.

In this study, the data has a three-level hierarchal structure in which 11,968 households are nested within 30 zones, and the 30 zones are nested within 6 regions. Clustering the observations within higher-level units can result in a hierarchically structured dataset in which observations are not independent. A multi-level statistical approach was used to model the relation between count of children and the explanatory variables. The first level represents the households (married couples), the second level is zone and the third level is region. Observations were obtained in households nested within zones. Fitting a normal model to these data can cause negative predications [25]. Therefore, we applied a multi-level count model based on the poisson distribution with random intercept to account for hierarchal structure of the observations and to avoid any bias resulted from fitting a linear model to count data. A multi-level mixed effects model with Poisson regression was used to assess the independent effects of the explanatory variables on the count of children.

Results

Background characteristics

Figure 2 shows number of births by region and zone in Ethiopia. The mean of number of births is different from region: Tigray 2.2, Amhara 2.9, Oromia 3.5, Somali 3.5, SNNPR 5.3, and Addis Ababa 3.0. Number of births in SNNPR are more than twice as high as Tigray. Also, number of births is different from zone level in a few regions.

Table 1 explains socio-demographic differences by residence and attitude towards family planning. In rural area, most women had under secondary education. However, half of the women who reside in urban had high-educated. Attitude towards family planning in Somali region are poor (60.8%) than other regions. This might be due to the fact that Somali is pastoralist region. This implies that number of people are their power so that Somali people are negative towards reducing number of births.

To find out determinants of fertility with regional or zonal level, we fitted four different models (Table 2, 3). First, we fitted a bivariate mixed effect Poisson regression (Model A) and multivariate mixed effect Poisson regression (Model B) of children ever born by each socio-demographic variables. Model A included age of mother, age at first marriage, residence, contraceptive use, knowledge of any contraceptive method, breastfeeding, abortion, region, religion, mother's education, husband's education, and wealth index of house-hold. Most of these variables are

statistically significant. Surprisingly, contraceptive use did not show statistically significance in explaining fertility. According to Model A, respondents aged 45-49 years are 16 times more likely to have more children than those aged 15-19 years (Incidence rate ratio (IRR)=16.12, 95% Confidence interval (CI): 11.96-21.71). Respondents aged at first marriage over 23 years are about 44% less likely (IRR=0.56, 95% CI: 0.50-0.63) than aged at first marriage less than 15 years to have children. Similarly, respondents from urban are about 28% less likely (IRR=0.72, 95% CI: 0.68-0.76) than the rural women to have children. Moreover, women who have knowledge about any method of contraceptive are about 54% less likely (IRR=0.46, 95% CI: 0.43-0.50) to have children as compared to these with no knowledge. Mothers who had abortion are 1.43 times more likely (IRR=1.43, 95% CI: 1.32-1.55) to have children than mothers had no abortion. Furthermore, mothers from Oromia, Somali, SNNPR, respectively had 1.16, 2.68 and 1.24 times more and mothers from Amhara and Addis Ababa were 0.95 and 0.78 times less children compared to mothers from Tigray. Respondents whose religion are orthodox, catholic and protestant respectively had 0.58, 0.67 and 0.66 times less children compared to those Muslim. Also, women who had primary education, secondary, and higher education respectively had 0.55, 0.40 and 0.38 times less children compared to their uneducated counterparts. In perspective of wealth index, middle women had 1.12 times more children than lowest women and women from fourth or highest households have 30% higher fertility compared to those from lowest households.

Interestingly, region, husband's education, knowledge of any contraceptive method, breastfeeding, and wealth index, which independently have significant bivariate relationships with fertility levels, are not significant determinants of fertility among the respondents in the multivariate regression model. Model B showed that the adjusted incidence rate ratio (AIRR) of a woman aged 45-49 years is 20.59. This implies that women aged 45-49 years would 20.59 times more likely (AIRR=20.59, 95% CI: 11.02-38.46) to have children as those aged 15-19 years with the same level other factors. Also, respondents aged at first marriage over 23 years are 60% less likely (AIRR=0.40, 95% CI: 0.31-0.52) than the respondents aged at first marriage less than 15 years to have children holding all other factors constant. Respondents from urban are 18% less likely (AIRR=0.82, 95% CI: 0.68-0.98) than the respondents from rural to have children with all other predictors constant.

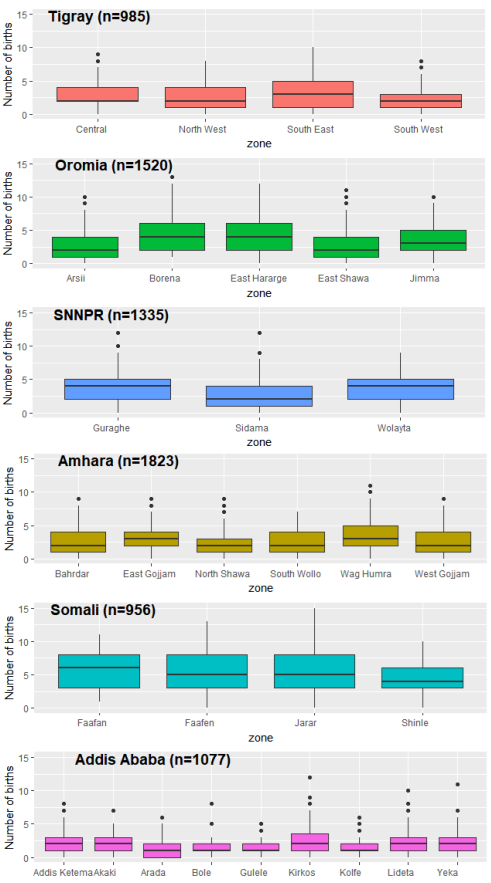

Figure 2. Number of births by region and zone

Table 3 reports the results from the random multi-level mixed effect poisson models. The random intercept model can capture group variation and show the relationship between children ever born and independent variables which vary randomly between zones and regions. The three-level model examines children ever born for the random samples of women, nested within 30 zones and within 6 regions. The estimated standard deviation in the average estimated children ever

born at level 2 is 0.28. The variance of the zone random effects (σ_z^2) is significantly different from zero which indicates that intercepts vary slightly over the zones. This suggests that there is a significant variation in determinant of fertility

Table 1. Socio-demographic variables by residence and attitude towards family planning

Socio-demographic variables		Residence		Level of attitude towards family planning	
		Rural (%)	Urban (%)	Poor (N, %)	Good (N, %)
Region	Tigray	15.4	10.4	555 (56.3)	430 (43.7)
	Amhara	13.1	33.6	710 (38.9)	1,113 (61.1)
	Oromia	27.8	12.2	577 (38.0)	943 (62.0)
	Somali	12.2	12.6	581 (60.8)	375 (39.2)
	SNNPR	31.4	4.2	365 (27.3)	970 (72.7)
	Addis Ababa	0.0	27.1	311 (28.9)	766 (71.1)
Religion	Islam	35.0	26.7	1,237 (52.3)	1,128 (47.7)
	Orthodox	41.2	65.0	1,561 (37.9)	2,554 (62.1)
	Catholic	1.6	0.9	23 (24.0)	73 (76.0)
	Protestant	21.2	7.1	263 (24.6)	805 (75.4)
	Others	1.0	0.3	15 (28.8)	37 (71.2)
Age	15-19	3.8	2.4	103 (43.8)	132 (56.2)
	20-24	16.4	14.8	453 (37.8)	744 (62.2)
	25-29	26.3	26.8	787 (38.5)	1,257 (61.5)
	30-34	23.2	21.9	690 (39.7)	1,046 (60.3)
	35-39	16.2	16.6	509 (40.3)	755 (59.7)
	40-44	8.7	10.2	344 (47.3)	384 (52.7)
	45-49	5.3	7.4	213 (43.3)	279 (56.7)
Education	No education	62.8	32.9	1,886 (51.7)	1,760 (48.3)
	Primary	24.0	20.1	585 (34.6)	1,107 (65.4)
	Secondary	9.1	21.8	327 (27.1)	878 (72.9)
	Tertiary	4.1	25.1	301 (26.1)	852 (73.9)
Wealth Index	Lowest	19.6	24.3		
	Second	20.4	15.5		
	Middle	20.6	14.4		
	Fourth	20.1	19.3		
	Highest	19.4	26.5		
Residence	Rural			1,658 (44.6)	2,062 (55.4)
	Urban			1,441 (36.2)	2,535 (63.8)

Table 2. Mixed effects Poisson regression of children ever born by women according to socio-demographic variables

Variables		Model A*	Model B†
		IRR‡ (95% CI)	AIRR§ (95% CI)
Age in 5-year group	15-19	1.00	1.00
	20-24	1.94 (1.44-2.62)	1.76 (1.02-3.02)
	25-29	2.28 (1.71-3.05)	2.46 (1.46-4.16)
	30-34	5.16 (3.86-6.90)	5.73 (3.37-9.76)
	35-39	6.03 (4.50-8.07)	6.12 (3.57-10.51)
	40-44	8.74 (6.51-11.74)	16.28 (9.13-29.03)
	45-49	16.12 (11.96-21.71)	20.59 (11.02-38.46)
Age at first marriage	< 15 years	1.00	1.00
	15-17 years	0.90 (0.82-1.00)	0.73 (0.58-0.93)
	18-20 years	0.80 (0.74-0.87)	0.56 (0.49-0.74)
	21-23 years	0.63 (0.57-0.70)	0.57 (0.45-0.72)
	> 23 years	0.56 (0.50-0.63)	0.40 (0.31-0.52)
Residence	Rural	1.00	1.00
	Urban	0.72 (0.68-0.76)	0.82 (0.68-0.98)
Contraceptive use	No	1.00	
	Yes	1.08 (0.98-2.00)	
Knowledge of contraceptive	No	1.00	1.00
	Yes	0.46 (0.43-0.50)	0.96 (0.76-1.20)
Breastfeeding	No	1.00	1.00
	Yes	0.68 (0.60-0.77)	1.06 (0.87-1.30)
Abortion	No	1.00	1.00
	Yes	1.43 (1.32-1.55)	1.48 (1.25-1.75)
Region	Tigray	1.00	1.00
	Amhara	0.95 (0.84-1.06)	1.00 (0.66-1.52)
	Oromia	1.16 (1.03-1.31)	1.19 (0.79-1.80)
	Somali	2.68 (2.36-3.05)	1.54 (0.97-2.46)
	SNNPR	1.24 (1.10-1.40)	1.36 (0.85-2.18)
	Addis Ababa	0.79 (0.69-0.90)	1.10 (0.72-1.70)
Religion	Muslim	1.00	1.00
	Orthodox	0.58 (0.54-0.62)	0.81 (0.67-0.96)
	Catholic	0.67 (0.51-0.72)	0.68 (0.33-1.39)
	Protestant	0.66 (0.60-0.72)	0.90 (0.72-1.12)
	Others	0.70 (0.51-0.97)	0.89 (0.47-1.67)
Mother's education	No education	1.00	1.00
	Primary	0.55 (0.51-0.59)	0.80 (0.67-0.96)
	Secondary	0.40 (0.37-0.44)	0.83 (0.67-1.04)
	Tertiary	0.38 (0.35-0.42)	0.80 (0.62-1.02)
Husband's education	No education	1.00	1.00
	Primary	0.61 (0.56-0.65)	0.97 (0.80-1.16)
	Secondary	0.45 (0.41-0.49)	0.98 (0.80-1.21)
	Tertiary	0.45 (0.42-0.49)	0.88 (0.71-1.08)
Wealth Index	Lowest	1.00	1.00
	Second	1.04 (0.94-1.14)	1.07 (0.89-1.28)
	Middle	1.12 (1.02-1.23)	0.99 (0.82-1.19)
	Fourth	1.29 (1.18-1.42)	0.92 (0.74-1.14)
	Highest	1.31 (1.19-1.43)	0.87 (0.70-1.10)

* Model A: Bivariate Poisson regression
† Model B: Multivariate Poisson regression
‡ IRR: Incidence rate ratio
§ AIRR: Adjusted incidence rate ratio

across the zones. Hence, the number of children ever born varies slightly across zones. The variance at the region level is also significant. Moreover, with respect to the two level model the variance component at the zonal level is reduced in the three level. The magnitude of these variance components indicates there is more variation among regions than zones in the number of children ever born.

Age at first marriage has a negative significant association with the number of children ever born in household. Therefore, increase age at first marriage is related to a lower probability of having more children. Whereas, the age of mother has a positive significant association with the number of children ever born. Moreover, mother who had abortion is related to a high probability of having more children. Also, fertility is lower among women living in the urban areas compared to those living in the rural areas, holding all other factors (AIRR in two level=0.84, AIRR in three level=0.83). It was observed that the level of mother education was found to be significantly associated with number of children holding all other factors constant. Women with low level of education were found to be more likely to have more children than women wo had high level of education. Thus, the higher education is associated with smaller family sizes holding all other variables constant. Women with more than secondary education show almost 20% decrease (AIRR of

Table 3. Random intercept model for the number of children ever born in household

Variables		Two level	Three level
		AIRR* (95% CI)	AIRR (95% CI)
Age in 5-year group	15-19	1.00	1.00
	20-24	2.00 (1.51-2.65)	1.99 (1.50-2.64)
	25-29	2.47 (1.87-3.25)	2.47 (1.87-3.25)
	30-34	5.54 (4.20-7.30)	5.52 (4.19-7.28)
	35-39	6.63 (5.02-8.74)	6.60 (5.01-8.71)
	40-44	9.12 (6.89-12.07)	9.10 (6.88-12.04)
	45-49	15.12 (11.28-20.07)	14.98 (11.28-19.89)
Age at first marriage	<15 years	1.00	1.00
	15-17 years	0.96 (0.89-1.04)	0.96 (0.89-1.04)
	18-20 years	0.85 (0.79-0.91)	0.84 (0.78-0.90)
	21-23 years	0.74 (0.68-0.81)	0.74 (0.67-0.81)
	> 23 years	0.60 (0.54-0.66)	0.59 (0.53-0.65)
Residence	Rural	1.00	1.00
	Urban	0.84 (0.79-0.90)	0.83 (0.78-0.89)
Religion	Muslim	1.00	1.00
	Orthodox	0.86 (0.80-0.93)	0.88 (0.80-0.93)
	Catholic	0.85 (0.68-1.06)	0.84 (0.68-1.03)
	Protestant	0.92 (0.82-1.03)	0.92 (0.81-1.04)
	Others	0.93 (0.71-1.21)	0.93 (0.71-1.22)
Abortion	No	1.00	1.00
	Yes	1.06 (1.01-1.13)	1.07 (1.00-1.14)
Mother's education	No education	1.00	1.00
	Primary	0.89 (0.84-0.96)	0.90 (0.84-0.91)
	Secondary	0.80 (0.73-0.87)	0.80 (0.73-0.79)
	Tertiary	0.79 (0.72-0.86)	0.79 (0.72-0.86)
Random part			
Level three: Region (σ_r)			0.34 (0.18-0.61)
Level two: Zone (σ_z)		0.28 (0.21-0.37)	0.11 (0.08-0.16)
Level one: Individual (σ_I)		0.66 (0.64-0.68)	0.66 (0.64-0.68)

* AIRR: Adjusted incidence rate ratio

secondary=0.80, AIRR of tertiary=0.79) in the level of fertility compared to women with no education. While when only the socio-demographic characteristics were considered (Model A), women with more than secondary education show almost 60% decrease in number of children compared with women who had no education (IRR of secondary=0.40, AIRR of tertiary =0.38).

Discussion

We examined the association between the determinants of fertility as well as socio-demographic characteristics of mothers. Accordingly, mother's age, age at first marriage, residence, and educations were found to be the individual factors which affect fertility levels. Mother's age was a significant determinants of fertility levels as older women had higher fertility levels than younger women. There are significant associations of delayed marriage and mothers' education with fertility level [7]. Women with low level of education were found to be have more children than women with high level of education. Thus, improving women's education and increase the age at first marriage would be a policy agenda in terms of family planning. Also, respondents who live in rural areas have more children than respondents from urban areas. These findings are similar to previous studies [7, 22]. Furthermore, this study found out that contraceptive use, knowledge of contraceptive, breastfeeding, abortion, religion, and wealth index were associated with fertility level. Interestingly, knowledge of contraceptive, breastfeeding, husband's education, and wealth index had significant bivariate relationships and had not significant multivariate relationships with fertility levels. A previous study conducted in North and South Gondar zones showed that breastfeeding was the most significant inhibitor of fertility [26]. Another survey showed that contraceptive use was a significant fertility inhibitor in urban areas such as Addis Ababa and among women who attended secondary and higher education [3]. Although this study found out that contraceptive use is associated with number of children ever born in household, contraceptive use has not yet a significant contributor of fertility decline at national target level. Hence, promoting use of contraceptives and breastfeeding could be important for declining fertility in Ethiopia and implementing of these combined social and health agenda need to be consistent with development strategy of Ethiopia.

In addition to assessing determinants of fertility, this study investigated regional and zonal variations. Both random effects of zone (σ_z) and region (σ_r) are significant and the magnitude of variance component was bigger at region than zone. This indicates that region and zone was associated with number of children ever born in household and region component could explain more than zone component in perspective of fertility level. There are significant variations in fertility levels across region and this trend of fertility in Ethiopia from EDHS 2016 showed a significant variation of fertility by region [3]. This study showed a decline in fertility in Amhara, Tigray, Oromia and SNNPR while it showed an increasing trend for Somali region and Afar zone. Thus, family planning program should give priorities to Muslim and pastoralist regions like Somali and Afar. Therefore, different interventions by regions or zones could be used to solve the existing problems of fertility. Also, this analysis revealed that people who live in Somali where most people believe in Allah, have low level of education, and live in rural areas had not good attitude towards family planning. In this regards, education, counseling and media messages on family planning should focus on this region for having a small family.

The present study has several limitations. Firstly, national-level survey should cover almost the vast majority of the country. However, we were not able to reach some of the remotest areas in some of the zones in Amhara, Oromia and Somali for security reasons. This might affect the representativeness of the study participants that is rural people are less represented. Secondly, although this study found the relationship between region or zone and number of children by some socio-demographic variables, we could not figure out which variables affect these relationships. Finally, national-level survey investigated both men and women, we checked only women. Therefore, stratified analyses by region, zone, socio-economic variables or sex need to be done by collaborating with a variety of stakeholders and experts such as local experts and religious leaders to understand different

background of regions or zones. This is because each region has different languages, religion and socio-economic status. Thus, family planning program should reflect the characteristics of region or zones. To do this, education, information, and campaigns of family planning should be tailored to the specific needs of the subpopulation in order to deliver effective family planning messages.

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