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Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2020-044060
Article Type:	Original research
Date Submitted by the Author:	22-Aug-2020
Complete List of Authors:	Alem, Adugnaw ; University of Gondar College of Medicine and Health Sciences, Epidemiology and Bio statistics Agegnehu, Chilot; University of Gondar College of Medicine and Health Sciences, School of Nursing ;
Keywords:	EPIDEMIOLOGY, Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Public health < INFECTIOUS DISEASES, EDUCATION & TRAINING (see Medical Education & Training)

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Magnitude and associated factors of unmet need for family planning among rural women in Ethiopia: a multilevel analysis

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Abstract

Objective: This study was aimed to assess the magnitude and associated factors of unmet need for family planning among rural women in Ethiopia.

Design: Cross-sectional study.

Setting: Ethiopia.

Participants: Reproductive age group women.

Primary outcome: Unmet need for family planning.

Methods: This study drawn data from 2016 Ethiopian Demographic and Health Survey (EDHS). A total of 8,327 rural reproductive-aged (15-49 years) women were included. The multilevel logistic regression model was carried out to identify factors associated with unmet need for family planning. Adjusted odds ratio (AOR) with a 95% CI was used to assess the strength of association between independent and dependent variables.

Results: The overall unmet need for family planning among rural women was 24.08% (95% CI: 23.17, 25.01) of which 14.79% was for spacing and 9.29% for limiting. Women's age (AOR=1.05;

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3 23 95%CI: 1.04,1.06), number of children (AOR=1.15; 95% CI: 1.07, 1.24), and working status of
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6 24 women (AOR=1.18; 95% CI: 1.02,1.37) were significantly associated with a higher odds of unmet
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8 25 needs for family planning. However, women with primary education (AOR=0.87; 95% CI:
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10 26 0.74,0.94), women married at age 18 or later (AOR=0.82; 95% CI: 0.70, 0.96), being rich (AOR=
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12 27 0.77; 95% CI: 0.64,0.94), distance to a health facility not the big problem (AOR=0.85; 95% CI: 0.73,
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14 28 0.99), women from communities with a high percentage of educated women (AOR=0.73; 95% CI:
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16 29 0.59, 0.89), and women who live in communities with high media exposure (AOR=0.81, 95% CI:
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18 30 0.68,0.98) were significantly associated with a lower odds of unmet needs for family planning.
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23 31 **Conclusion:** Unmet need for family planning among reproductive-aged women in rural Ethiopia
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25 32 was high. Women’s age, number of children, working status of women, women’s education, age
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27 33 at first marriage, wealth, distance to a health facility, community women’s education, and
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29 34 community media exposure were significantly associated with unmet needs for family planning.
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31 35 Therefore, public health policies and interventions that will strengthen women’s education,
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33 36 improve the existing strategies to increase the marital age of women, improve media exposure
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35 37 on family planning issues, and increase the wealth status of a household should be designed and
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37 38 implemented.
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40 39 **Keywords:** Unmet need, Family planning, Rural reproductive-aged women, Ethiopia
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46 40 **Strength and limitation of study**
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- 48 41 ✓ This study used nationally representative data, which was collected with standard and
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50 42 validated data collection tools.
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52 43 ✓ This study used an advanced model that accounts for the correlated nature of the EDHS
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54 44 data in the determination of estimates.
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- ✓ The cross-sectional nature of the survey does not show the temporal relationship between independent variables and outcome variable.
- ✓ Additionally, due to the use of secondary data essential factors such as knowledge and attitude of FP methods, fear of side effects, health worker training on FP and men's perspectives on contraceptive use were not available in the EDHS so that it was not possible to incorporate these variables in the analysis.

Background

Improving family planning (FP) is fundamental for Sustainable Development Goal (SDG) goals achievement. It is linked to human rights, gender equality, and empowerment, and has an impact on maternal, newborn, child, and adolescent health. Additionally, it has a role in shaping economic development and environmental and political futures.¹ Although sexual exposure and an expressed intention to avoid pregnancy, millions of women across the developing countries who don't use contraceptives prefer to space or limit the number of their children.² This indicates an unsatisfied demand for family planning, which is commonly referred to as unmet need for family planning. It refers percentage of fecund women who are married or living in union and thus presumed to be sexually active but are not using any family planning methods, either want to spacing (when the woman would have wished to delay the birth of her next child by at least 2 years) or limiting births (woman who do not want any more children).³

Unmet need for FP is a major public health concern in developing countries particularly in sub-Saharan Africa.⁴⁻⁷ In developing countries, the unmet need for modern FP methods increased from 225 million in 2014 to 230 million in 2019.^{6,7} In Ethiopia, the magnitude of overall unmet needs for family planning varied from 16.2 % to 34.6 %⁸⁻¹⁴ with 10.3% to 15.8 for spacing and

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3 67 6.0 to 9.8 for limiting.^{11,13,14} According to the Ethiopian Demographic and Health Survey (EDHS),
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6 68 it declined from 37% in 2000 to 22% in 2016.^{3,15} But the unmet need for family planning was a
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8 69 significant disparity in residence and regional states among women in Ethiopia that varied from
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11 70 19.1% to 28.0% in rural areas and 7.2% to 15.0% in urban areas.^{3,14,15} Despite Ethiopia introduced
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13 71 an ambitious community health program, relying on Health Extension Workers to address limited
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15 72 access to health services including family planning in rural areas, women in rural areas have high
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17 73 unmet for FP compared with women in urban areas.^{13,14,16,17}
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20 74 Unmet need for family planning is an essential concept that is largely used for reproductive health
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22 75 policies, as it bears serious consequences for the woman, the child, family, and society as a whole
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25 76 ¹⁸. It has consequences for women, such as unwanted pregnancy, unsafe abortion, closely spaced
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27 77 births, childbearing at a very early age, and physical abuse ^{18,19}, all of which are considered main
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29 78 contributors to preventable high maternal and infant mortality in many low and middle-income
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31 79 countries (LMICs).^{18,20} If all women with unmet need for family planning were to use FP, World
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33 80 Health Organization (WHO) estimated that maternal mortality could be declined by one third.²¹
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35 81 Moreover, in Ethiopia, if the unmet need of FP were satisfied more than 1 million under-five
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37 82 death could be prevented and nearly 13, 000 maternal mortalities would be declined over ten
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39 83 years' period.²² In addition, the use of contraceptives to regulate fertility either for child spacing
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41 84 or limiting childbearing is considered as an effective tool to control population ^{23,24} and related
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43 85 to high female literacy, gender equality, and poverty ^{25,26}. For these reasons, responding unmet
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45 86 need for family planning has become a crucial global health priority. Ethiopia has adapted
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47 87 sustainable development goals (SDGs) which has 17 goals, with Goal 3.1 reduce maternal
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88 mortality and goal 3.7 to ensure universal access to reproductive health services including family
89 planning.²⁷

90 Previous studies in Ethiopia^{8-14,16,17,28} have assessed factors associated with unmet need for FP
91 such as educational status of the women and their partners, partner attitude towards family
92 planning services utilization, healthcare providers visit, discussion about family planning with
93 their parents, numbers of desired children, place of residence, marital status, previous use of
94 family planning, parity, age at first marriage, media exposure, age, wealth, number of living
95 children visited, and attitude of respondents towards FP use. However, inconsistent results have
96 been reported in different settings in Ethiopia. For example, a study conducted in Debre Berhan
97 town revealed that having a discussion with husband was more likely to have unmet need for FP
98 ⁹, while a study in Shashemene town and Enemay district observed that lack of discussion
99 between partners was more likely to have unmet need for FP ^{12,13}. In addition, while numbers of
100 desired children >5 were positively associated with total unmet need in Shire-Enda- Slassie ¹¹, a
101 negative association was observed in Kersa District.⁸ These findings indicate that the need to take
102 the context into account when assessing factors associated with unmet need for FP.

103 Unmet need for FP is also associated with household-level and community-level factors.^{24,29}
104 Despite these previous studies in Ethiopia have assessed only individual-level factors and
105 community-level factors remained insufficiently explored. Additionally, unmet need remains high
106 in rural areas, yet there is a scarcity of information on the factors explaining it in rural Ethiopia.
107 Therefore, understanding the factors of unmet need for FP among women residing in rural
108 households will help public health practitioners working in FP programs to the identification,

131 Variables of study

132 Outcome variable

133 The main outcome variable was the need for FP where it combined both unmet need for spacing
 134 and unmet need for limiting form of unmet need. It refers to the proportion of women who desire
 135 to either delay the next pregnancy or limit child birth, but not using any method of contraception.
 136 It was a binary variable, women with unmet need for spacing or limiting were recoded as “unmet
 137 need”, while those using contraception for spacing or limiting or with no unmet need were
 138 recoded as “not unmet need”.

139 Independent variables

140 Based on literature^{8-14,16-18,23,24,29,31-37}, independent variables included in the analysis are broadly
 141 categorized as individual and community-level factors that are associated with unmet need for
 142 FP.

143 Individual-level variables considered in the analysis were age, women’s level of education (no
 144 education, primary, secondary, and higher), religion (recoded as Muslim, Orthodox, Protestant,
 145 and others), education level of husband (categorized as no education, primary, and
 146 secondary/higher), marital status (categorized as ever married and never married), working
 147 status (not working/working), exposure to the media (radio, magazine/newspaper or television)
 148 at least once a week were labeled as ‘yes’ and those who did not were labeled as ‘no’, wealth
 149 index (poorest and poorer categorized as “poor”, middle categorized as “middle”, and richer and
 150 richest categorized as “rich”), number of living children, desired number of children (categorized
 151 as <5 and ≥5), age at marriage (categorized as <18 and ≥18 years), pregnancy termination
 152 (yes/no), child death (yes/no), visited by field worker (yes/no), Visited health facility last 12

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153 months (yes/no), discussion on women's health care (categorized as women alone, jointly,
154 husband alone and others), and knowledge of ovulatory cycle recoded as “knowledgeable” if they
155 answer correctly (middle of the cycle) and otherwise recoded as “not knowledgeable”.

156 community-level factors such as community wealth, community women educational level,
157 community husband educational level, community media exposure, community working status,
158 and perceived distance to the health facility were defined as the proportion of women in the
159 poorest and poorer quintile, women with a minimum of primary level of education, husband with
160 a minimum of primary level of education, women exposed to at least one type of media; radio,
161 newspaper television, and internet, women who are working and women who perceived distance
162 to a health facility as a problem within a community respectively. Community-level factors,
163 namely, community wealth, community women educational level, community husband
164 educational level, community media exposure were constructed by aggregating individual-level
165 variables into community-level variables. Each aggregated community variables were divided
166 into low and high based on the national median value since they were not normally distributed.

167 **Statistical analysis**

168 All statistical analysis was performed using Stata version 14.0. Sample weighting was done before
169 doing any statistical analysis, to adjust for the non-proportional allocation of the sample to
170 different regions and their urban and rural areas as well as to adjust for the non-response rates.

171 Descriptive statistics using frequency and percentage were used to get an overview of the
172 selected variables. Multilevel logistic regression models were used to estimate the effects of
173 unmet need for FP factors at the two specified levels. It allows for the estimation of valid
174 standard errors by adjusting for the within-cluster correlation of the outcome variable ³⁸.

Four models were fitted. Firstly, model I, the empty or unconditional model, without covariates were performed. This model was used to estimate the random intercept at community and region level and the variation in the odds of unmet need for FP experience between communities. Secondly, model II was constructed by adding individual-level factors. Thirdly, model III was constructed by adding community-level factors. Finally, model IV including both individual-level community-level factors were constructed. Then, the appropriate model was selected using deviance and the model with the lowest deviance was fitted to estimate the association between independent factors and unmet need for FP. In addition, the measure of variance (random effects), which is the measure of residual errors at the individual level and community variation, was reported in terms of the intra-class correlation coefficient (ICC)³⁸ and proportional change in variance (PCV).³⁹

Firstly, bivariable multilevel logistic regression models were fitted and all variables with a p-value < 0.20 at bi-variable analysis were entered into the multivariable analysis. Then multivariable multilevel logistic regression model was performed to control for possible confounders. In multivariable multilevel logistic regression model odds ratios together with 95% CI were calculated and statistical significance was declared at p-value <0.05.

Ethical Consideration

Permission for data access was obtained from Major Demographic and Health Survey program through the online request from <http://www.dhsprogram.com>.

Patient and public involvement statement

In this study, patients and the public were not involved in the study design or planning of the study. Furthermore, since we used secondary analysis EDHS data patients were not consulted to

interpret the results and were not invited to contribute to the writing or editing of this document for readability or accuracy.

Results

In this study, a total of a weighted sample of 8,327 women in reproductive age were included. The mean age of the study participants was 29.08±7.71 years. Most of them were orthodox (n = 3,262, 39.2%), ever married (n = 8,158, 98.0%), married before 18 years of age (n = 6,193, 75.9%), desire to have five or more children (n = 4,511, 54.2), and were not exposed to media (n = 6,729, 80.2%). Regarding educational status, nearly two-third (n = 5,449, 65.4%) of women and nearly half of their parents (n =3,801, 50.3%) had no formal education (**Table 1**).

Magnitude of unmet for family planning

In this study overall unmet need for FP among rural women was 24.08% (95%CI: 23.17, 25.01) of which 14.79% (95%CI: 14.04, 15.57) was for spacing and 9.29% (95%CI: 8.68, 9.93) for limiting (**Figure 1**).

Factors associated with unmet need for FP.

Random effect model

As presented in table 2, in the null model, about 9.6% of the total variance in the unmet need for FP was at the community level and may be attributable to other unobserved community factors (ICC = 0.096). In the final model (model IV), as indicated by the PCV 17.2% of the variation in unmet need for FP across communities was explained by both individual and community-level factors. Additionally, the final model indicates that the lowest MOR value (1.67) which showed

the effects of community heterogeneity. Model IV with the lowest deviance was used to identify significantly associated factors with unmet need for FP.

Fixed effect model

After adjusting for possible confounders, age, women education level, wealth of household, number of children, age at first marriage, working status, distance from the health facility, community husband education, and community media exposure were significantly associated with unmet need for FP in Ethiopia.

As age of women increases the odds of unmet need for FP increases (AOR=1.05; 95% CI: 1.04,1.06). The odds of unmet need for FP among women who attend primary education was 13% (AOR=0.87; 95% CI: 0.74,0.94) lower as compared with women with no formal education. As number of children increases the odds of unmet need for FP increases (AOR=1.15; 95% CI: 1.07, 1.24). Working status of women also affect unmet need for FP positively (AOR=1.18; 95% CI: 1.02,1.37). Women married at age 18 or later had 18% (AOR=0.82; 95% CI: 0.70, 0.96) lower odds of unmet need for FP as compared to marital age less than 18. Additionally, considering the wealth index, the odds of unmet need for FP among women from richer/richest class was 23% (AOR= 0.77; 95% CI: 0.64,0.94) lower as compared with women from the poorer/poorest class. Among community factors, the odds of unmet for FP among women complaining about the distance to a health facility as not the big problem was decreased by 15% (AOR=0.85; 95% CI: 0.73, 0.99) compared with their defined counterparts. Moreover, women from communities with high percentage of educated women (AOR=0.73; 95% CI: 0.59, 0.89) was less likely to have unmet need for FP compared with women from communities with a low percentage of educated women. Similarly, this study further reveals that women who live in communities with high media

exposure were associated with decreased odds of unmet need for FP compared to women in the reference category (AOR=0.81, 95% CI: 0.68,0.98) (Table 2).

Discussion

This study was conducted to investigate the magnitude and factors of unmet need in FP among rural women in the reproductive age group. This study made contributions to the literature on unmet need for FP since it focused rural women which have high unmet for FP prevalence and has only been covered in few studies on unmet need for FP in the rural areas. Identifying specific factors associated with unmet need for family planning in a rural area has therefore been brought further to the fore of national family planning awareness and improving access to reproductive health services, as this is critical for achieving SDG five.⁴⁰ Additionally, this study extended factors associated with unmet need for FP by considering community-level factors that may shape the level of unmet need for family planning in Ethiopia. This provides information on a wider range of factors to be targeted by family planning policymakers in the country.

The current study revealed that 24.08% (95%CI: 23.17, 25.01) of rural women in reproductive age in Ethiopia had total unmet need for FP. The result is lower than a study conducted in Ethiopia,^{8-10,12,13} Ghana,⁴¹ and Cameroon.³⁶ This discrepancy could be explained by the fact that the previous studies conducted in Ethiopia^{8-10,12,13} were small scale surveys compared to the EDHS which were nationally representative survey and covered more women in the region. The discrepancy could be due to the differences in studied populations and background characteristics differences among participants. For example, assessing unmet need of long-acting and permanent family planning methods¹² and among young married women⁸ in Ethiopia, and unmet need among HIV positive women in Ghana⁴¹ versus assessing unmet need among

reproductive-age group women in our study. From background characteristics differences among participants the proportion of women who were married in this study was 98.0%, and in the Cameroon study, it was 61.1%.³⁶ Previous study implies that married women had 59% lower odds of unmet need for FP compared to never married women.²⁴

However, the magnitude of unmet need for FP in this study was higher than a study conducted in Ethiopia,^{11,14} Sudan,³¹ Burkina Faso,¹⁸ Malawi,²⁴ Cameroon,³² and Nigeria.²⁹ This variation might be attributed to the differences in study population and study setting. The current study exclusively includes rural women. In most part of Ethiopia, rural residents have usually low health services coverage and decreased awareness of FP due to low education, low socioeconomic status, and have limited access to FP services this may lead to a higher prevalence of unmet need in rural areas. Therefore, this provides information on rural residents to be targeted by family planning policymakers in the country because the high unmet need for FP further exposes women to unintended pregnancies and unsafe abortion which raises the risk of maternal and child death.^{18,20,42,43} Another possible explanation for the difference in the prevalence of unmet need could be the difference in the educational level of study participants. For instance, a previous study done in Ethiopia reported that 41.6% of women have no formal education which was lower than that of this study (65.4%). Moreover, a study conducted in Sudan reveals that 51.1% of women were secondary education which was higher than that of the current study (3.6%). Previous literature documented that educational level has a negative relationship with unmet need for FP.^{12,13,16,24,28,29,33,44,45} Therefore, expansion of women's education which is currently poor as found in the current study is recommended to increase awareness and to reduce unmet need for FP among women in rural areas. A higher proportion was observed for

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unmet need for spacing in comparison with that for limiting (14.79% Vs 9.28%). This finding is in line with other studies conducted in different parts of Ethiopia,^{11,13,14} Sudan,³¹ and Cameroon ^{32,36} where unmet need for spacing contributed to a higher proportion of the total unmet need.

In this study age of women was statistically significant that as age of women increased, the magnitude of unmet need also increased. Similarly, a study conducted in Ethiopia^{8,11,13} and Malawi²⁴ reveals that unmet need for family planning was higher among older women than younger women. This could be because older women near to menopause may perceive as low risk to the pregnancy and because of near schooling period among younger creates better awareness on unmet need for FP. Older women are considered to have more children than younger women might be another possible explanation of this association.

In this study, women’s education is another most important variable which significantly associated with unmet need for FP. That is women with primary education were less likely to report having an unmet need for FP as compared to women without education. This is congruent with the study conducted in Ethiopia,^{12,13,16,28,44} Nigeria,²⁹ Malawi,²⁴ Burundi,⁴⁵ and LMICs .³³ This might be due to women who attained education are more exposed to family planning through media and other modes of exposure which improves access to FP alternatives and helps them to understand the health benefits of the FP to reduce fertility, maternal and child morbidity and mortality. It suggests that educated women are more likely to gain family planning services because education of women makes them more empowered in decision making regarding contraceptive use.⁴⁶ Furthermore, the educational status of women is directly related to economic and social empowerment which increased exposure to resources such as access to media and utilization of desired health care delivery services. Our study contradicts the finding

of studies conducted in Ethiopia,^{14,44} Sudan,³¹ Burundi,⁴⁵ Nigeria,³⁴ Kenya,⁴⁷ and Nepal,⁴⁸ which have reported educated women coincides with higher odds of unmet need for FP. These findings indicate that the need to take the context into account when assessing factors associated with unmet need for FP.

A lower proportion of unmet need for FP was observed among women in the rich wealth quantile. Results of this study show that women who were in the rich wealth quintile were 23% less likely to have unmet need for FP than women who belong to the poor quintile; this is in line with the results of other studies conducted in Ethiopia,¹⁴ Kenya,⁴⁷ Burundi,⁴⁵ Nigeria,³⁴ and Pakistan.²³ This may be due to our result reveals women in the rich category were most of them attend higher education but those in the poor category were most of them are not educated. Additionally, most of the women in the rich category are exposed to media (54.0%) as compared with women in the poor category (23.7%). Education and mass media exposure could probably give women a better chance to understand the uses of family planning and the negative effects of family planning methods thereby increased their consistent use.

The current study found that women who had been working within the 12 months preceding the survey had higher odds of having unmet for FP. This finding is supported by studies in Ethiopia¹⁶ and Malawi²⁴. The possible explanation for this association might be because women who were working can have a good income so they may be able to afford private health facilities compared with their counterparts.⁴⁹ Moreover, women who were working would have a great deal of trust and decision-making ability on health services including FP.^{49,50}

Consistent with previous studies,^{10,11,18,29,33,34,45,47,48} our study indicates that unmet need for FP is positively associated with the number of children, in which an increased number of children is

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3 327 associated with the higher odds of unmet need for FP. This would be due to even though women
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6 328 with many children actually want to either to delay the birth of her next child or limiting births,
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8 329 they are not empowered to use family planning by the socio-cultural setting in rural areas ^{16,51}.
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11 330 Therefore, it is important to empower women to use family planning in rural areas by increasing
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13 331 contraceptive information through mass media, education, and communication program in the
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15 332 country to specifically target women with many children.
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18 333 We also identified as the first marital age increased, the level of unmet need was decreased.
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20 334 Women married at age 18 or later had lower odds of unmet need for FP as compared to marital
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22 335 age less than 18. This finding is similar to a study conducted in Enemay District and Gonji Kolela
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24 336 District, Ethiopia,^{13,52} but it disagrees with another study done in Southern Nations, Nationalities
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26 337 and Peoples Region, Ethiopia.¹⁶ This might be due to women who marry at age 18 or later were
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28 338 able to plan and decide their family size because they had more exposure to FP methods and
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30 339 were mature enough to use FP. In addition, to increase unmet need for FP, child marriage
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32 340 (marriage before their 18th birthday) raises the risk of early childbearing of a mother, low
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34 341 economic status of women, termination of education, psychological impact, higher rates of
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36 342 divorce, a number of poor social and physical outcomes for young women, and their offspring,
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38 343 complications of pregnancy and an increased risk of both mother and child mortality.^{53–55} This
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40 344 implies policymakers should strive to create awareness and implement the legal age for marriage
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42 345 so as to increase the marital age ≥ 18 years to contribute to the decrement of unmet need for FP
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44 346 and its consequences.
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47 347 Similar to a study conducted in Malawi ²⁴ this study found that unmet need for FP was found high
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49 348 among women complaining about the distance to a health facility as a big problem. This finding
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suggests improving geographical access to health facilities decreases unmet need for FP. This could be explained by women who live closest to health facility are more likely to receive appropriate maternal healthcare services and increase in distance for health facility makes difficult to access maternal healthcare services among women.^{56–58} Previous studies reveal that women who receive maternal healthcare services (postnatal care and antenatal care) was significantly associated with a higher prevalence of contraception than women who did not receive any maternal healthcare services.^{59,60}

Furthermore, the current study reveals that community-level factors were also associated with the unmet need for FP. Unmet need for FP was found to be lower among women from communities with a high percentage of educated husband. Which is inconsistent with a study conducted in Malawi.²⁴ The result of this study further reveals that women who live in communities with high media exposure were associated with decreased odds of unmet need for FP compared to women in the reference category. This might be due to educated women have higher odds of understanding health messages and demand services. Additionally, educated women and women from rich households are more likely to be empowered which may subsequently increase accessing information and affording private health facilities to access FP services.^{61,62} Mass media is an important tool for mobilizing community to use FP service.²⁸

Therefore, women from communities with a high percentage of exposure to media and educated women may learn from others on the benefit of using FP services and where these may be accessed.

Strength and limitations

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3 370 The main strength of this study was it used large population-based data with a large sample size,
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6 371 which more representative of the entire population of rural Ethiopia. Furthermore, multilevel
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8 372 logistic regression was applied for this study that can be able to identify the contextual factors in
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10 373 the occurrence of unmet need for FP among rural women of reproductive age. Despite its
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12 374 strength, the findings of this study have limitations. Due to the cross-sectional nature of the EDHS
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14 375 data, it does not show temporal relationship between independent variables and outcome
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16 376 variable. Additionally, due to the use of secondary data essential factors such as knowledge and
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18 377 attitude of FP methods, fear of side effects, health worker training on FP and men’s perspectives
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20 378 on contraceptive use were not available in the EDHS so that it was not possible to incorporate
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22 379 these variables in the analysis.
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28 380 **Conclusion**

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30 381 This study has shown that unmet need for family planning among reproductive-aged women in
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32 382 rural Ethiopia was high. Women’s age, number of children, and working status of women were
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34 383 significantly associated with higher odds of unmet needs for family planning. However, women
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36 384 with primary education, women married at age 18 or later, being rich, distance to a health facility
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38 385 not the big problem, women from communities with a high percentage of educated women and
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40 386 women who live in communities with high media exposure were significantly associated with a
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42 387 lower odds of unmet needs for family planning. Therefore, public health policies and
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44 388 interventions that will strengthen women’s education, improve the existing strategies to increase
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46 389 the marital age of women, improve media exposure of women on family planning issue and
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48 390 increase the wealth status of household should be designed and implemented.
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55 391 **List of abbreviations**

392 AOR: Adjusted Odds Ratio; CI: Confidence Interval; EDHS: Ethiopian Demographic and Health
393 Survey; ICC: Intraclass Correlation Coefficient; FP: Family Planning; LLR: Loglikelihood Ratio; MOR:
394 Median Odds Ratio; PCV: Proportional Change in Variance

395 **Consent for publication**

396 Not applicable

397 **Availability of data and materials**

398 The datasets used and/or analyzed during the current study is available in a public, open access
399 repository which is accessible online <http://www.dhsprogram.com>.

400 **Competing interests**

401 The authors declare that they have no competing interests.

402 **Funding**

403 The authors received no specific funding for this work.

404 **Authors' contributions**

405 AZA: developed the concept, reviewed literature, carried out the statistical analysis, interpreted
406 the results and prepared the manuscript. CDA: reviewed literature, involved in analysis,
407 interpretation and prepared the manuscript. Both the authors read and approved the
408 manuscript.

409 **Acknowledgements**

410 We would like to acknowledge Major Demographic Health and survey (DHS) program which
411 granted us the permission to use DHS data.

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Figure legend

Figure 1: Magnitude of unmet contraceptive need among rural women in Ethiopia

Table 1: Background characteristics of respondents in Ethiopia, EDHS 2016

Variables	Frequency	Percent
Marital status		
Ever married	8,158	98.0
Never married	169	2.0
Education of respondent		
No education	5,449	65.4
Primary	2,497	30.0
Secondary	301	3.6
Higher	80	1.0
Educational status of husband		
No education	3,801	50.3
Primary	3,016	39.9
Secondary/above	736	9.8
Wealth index		
Poor	3,863	46.4
Middle	2,005	24.1
Rich	2,459	29.5
Religion		
Orthodox	3,262	39.2
Protestant	1,824	21.9
Muslim	3,011	36.1
Others	230	2.8
Working status		
No	6,067	72.9
Yes	2,260	27.1

Media exposure		
No	6,729	80.2
Yes	1,598	19.8
Knowledge of ovulatory cycle		
Knowledgeable	1,681	20.2
Not knowledgeable	6,646	79.8
Ideal number of children you want		
<5	3,816	45.8
≥5	4,511	54.2
Age at marriage		
<18 years	6,193	75.9
≥18 years	1,964	24.1
Pregnancy termination		
No	7,560	90.8
Yes	767	9.2
Child death		
No	7,175	95.7
Yes	372	4.3
Distance from health facility		
Big problem	5,106	61.3
Not big problem	3,221	38.7
Visited by field worker		
No	5,859	70.4
Yes	2,468	29.6
Visited health facility last 12 months		
No	6,068	72.9
Yes	2,259	27.1

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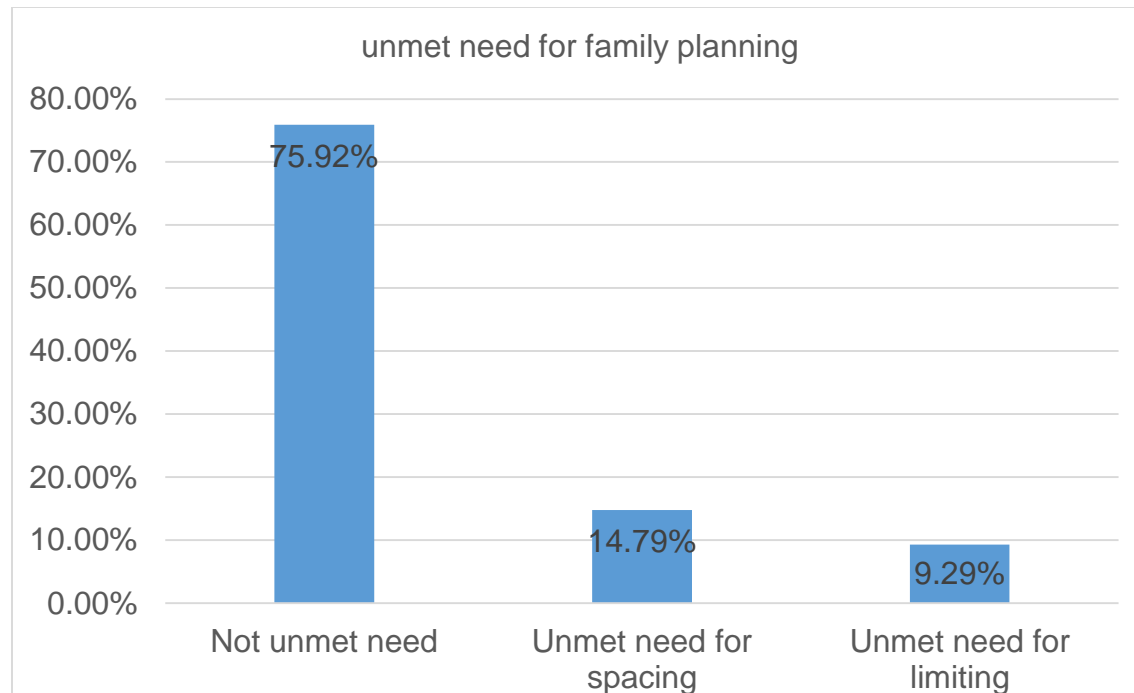
Table 2: Multi-level logistic regression analysis for factors associated with unmet need for FP among reproductive-age women in Ethiopia, EDHS 2016

Variables	Model 1	Model 2 (AOR with 95 % CI)	Model 3 (AOR with 95 % CI)	Model 4 (AOR with 95 % CI)
Age		1.05 (1.04, 1.06)		1.05 (1.04, 1.06)*
Level of women education				
No education		1		1
Primary		0.91 (0.80, 0.98)		0.87 (0.74, 0.94)*
Secondary		1.08 (0.71, 1.61)		1.09 (0.73, 1.64)
Higher		0.90 (0.39, 2.09)		0.91 (0.39, 2.11)
Working status of respondents				
Not working		1		1
working		1.21 (1.04, 1.40)		1.18 (1.02, 1.37)*
Type of media exposed				
No		1		1
Yes		0.87 (0.72, 1.05)		0.84 (0.69, 1.02)
Husband education				
No education		1		1
Primary		1.28 (1.08, 1.52)		1.23 (0.97, 1.33)
Secondary/above		1.13 (0.88, 1.44)		1.07 (0.84, 1.38)
Wealth Index				
Poor		1		1
Middle		0.94 (0.78, 1.12)		0.93 (0.77, 1.11)
Rich		0.77 (0.64, 0.94)		0.77 (0.64, 0.94)*
Age at marriage				
<18		1		1
≥18		0.82 (0.70, 0.96)		0.82 (0.70, 0.96)*
Religion				

Orthodox	1	1
protestant	1.08 (0.86, 1.36)	1.01(0.79, 1.2)
Muslim	1.14 (0.94, 1.38)	1.13(0.93, 1.38)
Others	1.64 (1.05, 2.56)	1.60 (1.03, 2.50)
Child death		
No	1	
Yes	1.19 (0.84, 1.69)	1.18 (0.84,1.68)
Pregnancy termination		
No	1	
Yes	0.94 (0.75, 1.17)	0.94 (0.75, 1.17)
Number of alive children	1.16 (1.07, 1.25)	1.15 (1.07, 1.24)*
Desire number of children		
<5	1	1
≥5	0.97 (0.84, 1.13)	0.99 (0.86, 1.15)
Distance from health facility		
Big problem	1	1
Not big problem	0.86 (0.76, 0.98)	0.85 (0.73, 0.99)
Community women education		
low	1	1
High	0.78 (0.64, 0.93)	0.73 (0.59, 0.89)*
Community husband education		
low	1	1
High	1.17 (0.97, 1.14)	1.15 (0.94, 1.41)
Community wealth		
Low	0.83 (0.61, 1.12)	1
High		0.90 (0.66, 1.24)
Community media exposure		
Low	1	1

High			0.89 (0.75, 1.06)	0.81 (0.68, 0.98)*
Community working status				
Low			1.35 (1.04, 1.76)	
High				1.15 (0.87, 1.51)
Random effects and model comparison				
Community level	0.35(0.056)	0.32 (0.059)	0.30 (0.053)	0.29 (0.057)
variance (SE)				
ICC (%)	9.6	8.7	8.4	8.1
Deviance (-2LL)	7121.163	6140.094	7078.809	6125.343
PCV (%)	Ref	8.6	14.3	17.2
MOR	1.75	1.71	1.68	1.67

*P value <0.05



STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of cross-sectional studies

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	1
Introduction			3-5
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4&5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			6-9
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7 & 8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7 & 8
Bias	9	Describe any efforts to address potential sources of bias	
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Not applicable
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	8 & 9
		(b) Describe any methods used to examine subgroups and interactions	Not Applicable
		(c) Explain how missing data were addressed	Not Applicable
		(d) If applicable, describe analytical methods taking account of sampling strategy	8 & 9
		(e) Describe any sensitivity analyses	Not Applicable
Results			10-12
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility,	10

		confirmed eligible, included in the study, completing follow-up, and analysed	
		(b) Give reasons for non-participation at each stage	Not Applicable
		(c) Consider use of a flow diagram	Not Applicable
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	10
		(b) Indicate number of participants with missing data for each variable of interest	Not Applicable
Outcome data	15*	Report numbers of outcome events or summary measures	10
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	11 & 12
		(b) Report category boundaries when continuous variables were categorized	7
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Not Applicable
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Not Applicable
Discussion			13-15
Key results	18	Summarise key results with reference to study objectives	11 & 12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	2 & 3
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12-17
Generalizability	21	Discuss the generalisability (external validity) of the study results	12
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	19

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

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Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2020-044060.R1
Article Type:	Original research
Date Submitted by the Author:	13-Feb-2021
Complete List of Authors:	Alem, Adugnaw ; University of Gondar College of Medicine and Health Sciences, Epidemiology and Bio statistics Agegnehu, Chilot; University of Gondar College of Medicine and Health Sciences, School of Nursing ;
Primary Subject Heading:	Public health
Secondary Subject Heading:	Epidemiology
Keywords:	EPIDEMIOLGY, Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Public health < INFECTIOUS DISEASES, EDUCATION & TRAINING (see Medical Education & Training)

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Magnitude and associated factors of unmet need for family planning among rural women in Ethiopia: a multilevel cross-sectional analysis

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Abstract

Objective: This study was aimed to assess the magnitude and associated factors of unmet need for family planning among rural women in Ethiopia.

Design: Cross-sectional study.

Setting: Ethiopia.

Participants: Reproductive age group women.

Primary outcome: Unmet need for family planning.

Methods: This study drew data from Ethiopian Demographic and Health Survey (EDHS) which is conducted from January 18 to June 27, 2016. A total of 8,327 rural reproductive-aged (15-49 years) women were included. A two-level multivariable logistic regression model was carried out to identify factors associated with unmet need for family planning. Adjusted odds ratio (AOR) with a 95% CI was used to assess the strength of association between independent and dependent variables.

Results: The overall unmet need for family planning among rural women was 24.08% (95% CI: 23.17, 25.01) of which 14.79% was for spacing and 9.29% for limiting. Women’s age (AOR=1.05; 95%CI: 1.04,1.06), number of children (AOR=1.15; 95% CI: 1.07, 1.24), and working status of women (AOR=1.18; 95% CI: 1.02,1.37) were significantly associated with a higher odds of unmet need for family planning. However, women with primary education (AOR=0.87; 95% CI: 0.74,0.94), women married at age 18 or later (AOR=0.82; 95% CI: 0.70, 0.96), women from households with high wealth index (AOR= 0.77; 95% CI: 0.64,0.94), women who deem distance to a health facility as not a big problem (AOR=0.85; 95% CI: 0.73, 0.99), women from communities with a high percentage of educated women (AOR=0.73; 95% CI: 0.59, 0.89), and women who live in communities with high media exposure (AOR=0.81, 95% CI: 0.68,0.98) were significantly associated with a lower odds of unmet needs for family planning.

Conclusion: Unmet need for family planning among reproductive-aged women in rural Ethiopia was high. Women’s age, number of children, working status of women, women’s education, age at first marriage, wealth, distance to a health facility, community women’s education, and community media exposure were significantly associated with unmet needs for family planning. Therefore, to reduce unmet need for family planning public health policymakers should consider both individual and community-level factors when designing FP programs and emphasis should be given to high-risk populations.

Keywords: Unmet need, Family planning, Rural reproductive-aged women, Ethiopia

Strength and limitation of study

- ✓ This study used nationally representative data, which was collected with standardized and validated data collection tools.

- 44 ✓ This study used an advanced model that accounts for the correlated nature of the EDHS
45 data in the determination of estimates.
- 46 ✓ The cross-sectional nature of the survey does not show the temporal relationship
47 between independent variables and outcome variable.
- 48 ✓ Additionally, due to the use of secondary data, essential factors such as knowledge and
49 attitudes about family planning (FP) methods, fear of side effects, health worker training
50 on FP and men's perspectives on contraceptive use were not available in the EDHS;
51 therefore, these factors were not included in our analysis.

52 Background

53 Improving family planning (FP) access is fundamental for Sustainable Development Goal (SDG)
54 goals achievement. It is linked to human rights, gender equality, and women's empowerment,
55 and has an impact on maternal, newborn, child, and adolescent health.¹ Additionally, it has a
56 role in enhancing broad socio-economic development, improving environmental preservation,
57 and reducing poverty.^{1,2} Although sexual exposure and an expressed intention to avoid
58 pregnancy, millions of women across the developing countries who don't use contraceptives
59 prefer to space or limit the number of their children.³ This indicates an unsatisfied demand for
60 family planning, which is commonly referred to as unmet need for family planning. It refers to
61 the percentage of fecund women who are married or living in union and thus presumed to be
62 sexually active but are not using any family planning methods, who either want to spacing (when
63 the woman would have wished to delay the birth of her next child by at least 2 years) or limiting
64 births (woman who do not want any more children).⁴

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3 65 Although Ethiopian government incorporated FP as one of essential health services provided at
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6 66 the community level by health extension workers, family planning utilization is low.⁵ In the
7
8 67 country, the overall utilization of FP methods among women was 36% (35% were using a modern
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10 68 method and 1% were using a traditional method).⁴
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12
13 69 Unmet need for FP is a major public health concern in developing countries particularly in sub-
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15 70 Saharan Africa.^{6–9} In developing countries, 225 million women had an unmet need for modern FP
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17 71 methods in 2014, and 230 million women experiencing unmet need for modern FP methods in
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19 72 2019.^{8,9} The prevalence of unmet need for FP among reproductive age group women was 18.3%
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21 73 (15.1% for spacing and 3.2% for limiting) in Burkina Faso,¹⁰ 21.0% (12.6% for spacing and 8.4%
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23 74 for limiting) in Malawi,¹¹ 46.6% (31.1% for spacing and 15.5% for limiting) in Cameroon,¹² 15.8%
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25 75 (15.1% for spacing and 0.7% for limiting) in Sudan,¹³ and 36. 9% in Ghana.¹⁴ In Ethiopia, the
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27 76 magnitude of overall unmet needs for family planning varied from 16.2 % to 34.6 % ^{15–21} with
28
29 77 10.3% to 15.8 for spacing and 6.0 to 9.8 for limiting.^{18,20,21} According to the Ethiopian
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31 78 Demographic and Health Survey (EDHS), overall unmet need for FP declined from 37% in 2000 to
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33 79 22% by 2016.^{4,22} But the unmet need for family planning was a significant disparity in residence
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35 80 and regional states among women in Ethiopia that varied from 19.1% to 28.0% in rural areas and
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37 81 7.2% to 15.0% in urban areas.^{4,21,22} Despite Ethiopia introduced an ambitious community health
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39 82 program, relying on Health Extension Workers to address limited access to health services
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41 83 including family planning in rural areas, women in rural areas have high unmet for FP compared
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43 84 with women in urban areas.^{20,21,23,24} Therefore, this study investigated factors associated with
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45 85 unmet need for FP among reproductive-age women in rural Ethiopia.
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Unmet need for family planning is an essential concept that is largely used for reproductive health policies, as it bears serious implications for the woman, the child, family, and society as a whole.

¹⁰ Reducing unmet need for family planning would significantly reduce unwanted pregnancy, unsafe abortion, closely spaced births, childbearing at a very early age, and physical abuse,^{10,13} all of which are considered main contributors to preventable high maternal and infant mortality in many low and middle-income countries (LMICs).^{10,25} If all women with unmet need for family planning were to use family planning, World Health Organization (WHO) estimated that maternal mortality could be declined by one-third.²⁶ Moreover, in Ethiopia, if the unmet need for FP were satisfied more than 1 million deaths of children under the age of 5 could be prevented and nearly 13,000 maternal mortalities would be declined over ten years period.²⁷ In addition, the use of contraceptives to regulate fertility either for child spacing or limiting childbearing is considered as an effective tool to control population growth^{11,28} and is related to higher female literacy, gender equality, and poverty ^{29,30}. For these reasons, responding to unmet need for family planning has become a crucial global health priority. Ethiopia has adapted sustainable development goals (SDGs) which have 17 goals, with Goal 3.1 reduce maternal mortality and goal 3.7 to ensure universal access to reproductive health services including family planning.³¹ Even though Ethiopia's Health Sector Development Plan target to reduce maternal mortality to 267 per 100,000 live births by 2015, maternal mortality in the country is 412 per 100,000 live births in 2016.^{4,32}

A variety of literature have assessed factors associated with unmet need for FP such as educational status of the women and their partner,^{13,19,20,28,33–38} partner attitudes towards family planning services utilization,^{17,20} healthcare providers visit at their home,^{20,33} discussion about

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3 108 family planning with their partner,^{16,39} numbers of desired children,^{10,15,20,35} place of
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6 109 residence,^{28,34,35,38} marital status,^{11,14,16,40} previous use of family planning,¹⁸ parity,^{14,15,17,21,41} age
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8 110 at first marriage,^{18,23} media exposure,^{15,28,33,35,42} age,^{11,15,18,28,34,35,37,38,43} wealth
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10 111 index/income,^{14,21,28,35} number of living children,^{10,28,33,37,38,42} experience of child death,^{35,38}
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12 112 knowledge about contraceptive methods,^{23,43} working status,¹⁴ fear of side effects,²⁸
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14 113 occupation,^{13,16,34} and the attitude of respondents towards family planning use.³³ However,
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16 114 inconsistent results have been reported in different settings in Ethiopia. For example, a study
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18 115 conducted in Debre Berhan town revealed that having a discussion with husband was more likely
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20 116 to have unmet need for FP,¹⁶ while a study in Shashemene town and Enemay district observed
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22 117 that lack of discussion between partners was more likely to have unmet need for FP. ^{19,20} In
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24 118 addition, while numbers of desired children >5 were positively associated with total unmet need
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26 119 in Shire-Enda- Slassie, ¹⁸ a negative association was observed in Kersa District.¹⁵ These findings
27
28 120 indicate that the need to take the study in the national or larger scale context into account when
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30 121 assessing factors associated with unmet need for FP.
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32 122 Unmet need for FP is also associated with household-level and community-level factors.^{11,38}
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34 123 Despite these previous studies in Ethiopia have assessed only individual-level factors, and
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36 124 community-level factors remained insufficiently explored. Additionally, unmet need remains high
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38 125 in rural areas, yet there is a scarcity of information on the factors explaining it in rural Ethiopia.
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40 126 Therefore, understanding the factors for unmet need for FP among women residing in rural
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42 127 households will help public health practitioners working in FP programs to the identify,
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44 128 implement, and evaluate evidence-based interventions to tackle the unmet need and expand
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46 129 contraception use by considering the effects of community characteristics.

130 **Methods**

131 **Study design period and setting**

132 This study was a cross-sectional study conducted using secondary data collected in the 2016
133 Ethiopian Demographic and Health Survey (EDHS). The Ethiopian Demographic and Health Survey
134 (EDHS) drew nationally representative samples for the Ethiopian population, which was collected
135 from January 18, 2016, to June 27, 2016. It is the fourth Demographic and Health Survey
136 conducted in Ethiopia includes data collected from nine regions and two administrative cities. A
137 detailed explanation of methodological strategies used in the EDHS has been outlined
138 elsewhere.⁴⁴

139 **Data source and extraction**

140 The study used secondary data from the Ethiopian Demographic and Health Survey (EDHS) 2016,
141 which is a nationally representative survey. The EDHS is a nationally representative survey using
142 a two-stage cluster sampling method. In the first stage, 645 clusters (202 urban areas and 443
143 rural areas) were randomly selected from the sampling frame (i.e. the 2007 Ethiopian population
144 and housing census) and household listing. The second stage involved a systematic selection of
145 18,008 households from the selected clusters, of which 17,067 were occupied. Of the occupied,
146 16,650 were successfully interviewed. The information we used was related to women of
147 reproductive ages (15-49 years). A total of 15,683 eligible women were identified for the survey.
148 Women who are never had sex/sexually inactive, and infecund were excluded from this study. A
149 total of a weighted sample of 8,327 women of reproductive age were included for analysis.

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Variables of study

Outcome variable

The main outcome variable was the unmet need for FP where it composed of both unmet need for spacing and limiting form of unmet need. It refers to the proportion of women who desire to either delay the next pregnancy or limit future pregnancies, but are not using any method of contraception.^{12,38} It was a binary variable, women with unmet need for spacing or limiting were recoded as “unmet need”, while those using FP methods for spacing or limiting or with no unmet need were recorded as “no unmet need”.

Independent variables

Based on the literature, independent variables included in the analysis are broadly categorized as individual and community-level factors that are associated with unmet need for FP.

Individual-level variables considered in the analysis were age, women’s level of education (no education, primary, secondary, and higher), religion (recoded as Muslim, Orthodox, Protestant, and others), education level of husband (categorized as no education, primary, and secondary/higher), marital status (categorized as ever married and never married), working status (not working/working), exposure to the media (categorized as “no” if there is no media exposure at all and “yes” if there is media exposure to either radio, magazine/newspaper, internet or television), wealth index (poorest and poorer categorized as “low”, middle categorized as “middle” ,and richer and richest categorized as “high”), number of living children, desired number of children (categorized as <5 and ≥5), age at marriage (categorized as <18 and ≥18 years), pregnancy termination (yes/no), child death (yes/no), visited by field worker at home (yes/no), visited health facility last 12 months (yes/no), discussion on women's health care

(categorized as women alone, jointly, husband alone and others), and knowledge of ovulatory cycle recoded as “knowledgeable” if they answer correctly (in the middle of the menstrual cycle) and otherwise recoded as “not knowledgeable”.

Community-level factors included in the study were community wealth, community women’s educational level, community husband’s educational level, community media exposure, and perceived distance to the health facility (big problem and not a big problem). Community wealth was defined as the proportion of women in the poorest and poorer quintile. Community women’s educational level was defined as the proportion of women with a minimum of primary level of education. Community husband educational level was defined as the proportion of husband with a minimum of primary level of education. Community media exposure was defined as the proportion of women exposed to at least one type of media such as radio, newspaper television, or internet. Community-level factors, namely, community wealth, community women’s educational level, community husband educational level, and community media exposure were constructed by aggregating individual-level variables into community-level variables. Each aggregated community variable was divided into low and high based on the median value since they were not normally distributed.

Statistical analysis

All statistical analysis was performed using Stata version 14.0. Sample weighting was done before doing any statistical analysis, to adjust for the non-proportional allocation of the sample to different regions and their urban and rural areas as well as to adjust for the non-response rates. Descriptive statistics using frequency and percentage were used to get an overview of the selected variables. Multilevel logistic regression models were used to estimate the effects of

unmet need for FP factors at the two specified levels. It allows for the estimation of valid standard errors by adjusting for the intra-cluster correlation of the outcome variable ⁴⁵.

Four models were fitted. Firstly, model I, the empty or unconditional model, without covariates was analyzed. This model was used to estimate the random intercept at community/cluster level and the variation in the odds of unmet need for FP experience between communities. Secondly, model II was constructed by adding individual-level factors. Thirdly, model III was constructed by adding community-level factors. Finally, model IV including both individual-level community-level factors was constructed. Then, the appropriate model was selected using deviance and the model with the lowest deviance was fitted to estimate the association between independent factors and unmet need for FP. In addition, the measure of variance (random effects), which is the measure of residual errors at the individual level and community variation, was reported in terms of the intra-class correlation coefficient (ICC)⁴⁵ and proportional change in variance (PCV).⁴⁶

Firstly, bivariable multilevel logistic regression models were fitted and all variables with a p-value < 0.20 at bi-variable analysis were entered into the multivariable analysis. Then multivariable multilevel logistic regression model was performed to control for possible confounders. In multivariable multilevel logistic regression models, odds ratios together with 95% confidence interval (CI) were calculated and statistical significance was declared at p-value <0.05.

Ethical Consideration

The data was accessed from the Demographic Health Survey Program at <http://www.dhsprogram.com>. Ethical approval was not needed because the study used publicly available data. However, permission to use the data for the study was obtained from the

216 Demographic Health Survey program. Informed consent was obtained at the beginning of each
217 interview by the EDHS data collectors.

218 **Patient and public involvement statement**

219 In this study, patients and the public were not involved in the study design or planning of the
220 study. Furthermore, as we used secondary analysis EDHS data patients were not consulted to
221 interpret the results and were not invited to contribute to the writing or editing of this document
222 for readability or accuracy.

223 **Results**

224 In this study, a total weighted sample of 8,327 women in reproductive age was included. The
225 mean age of the study participants was 29.08 ± 7.71 years. Most of them were Orthodox ($n =$
226 3,262, 39.2%), had ever been married ($n = 8,158$, 98.0%), married before 18 years of age ($n =$
227 6,193, 75.9%), desired to have five or more children ($n = 4,511$, 54.2), and were not exposed to
228 media ($n = 6,729$, 80.2%). Regarding educational status, nearly two-third ($n = 5,449$, 65.4%) of
229 women and nearly half of their parents ($n = 3,801$, 50.3%) had no formal education (**Table 1**).

230 **Magnitude of unmet for family planning**

231 In this study overall unmet need for FP among rural women was 24.08% (95%CI: 23.17, 25.01) of
232 which 14.79% (95%CI: 14.04, 15.57) was for spacing and 9.29% (95%CI: 8.68, 9.93) for limiting
233 (**Figure 1**).

234 **Factors associated with unmet need for FP.**

235 **Random effect model**

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3 236 As presented in table 2, in the null model, about 9.6% of the total variance in the unmet need for
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6 237 FP was at the community level and may be attributable to other unobserved community factors
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8 238 (ICC = 0.096). In the final model (model IV), as indicated by the PCV 17.2% of the variation in
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10 239 unmet need for FP across communities was explained by both individual and community-level
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13 240 factors. Additionally, the final model indicates that the lowest MOR value (1.67) which showed
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15 241 the effects of community heterogeneity. This means if we randomly select women from different
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17 242 clusters, women at the cluster with higher risk of unmet need for FP had 1.6 times higher odds
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19 243 of unmet need for FP as compared with those women at cluster with lower risk of unmet for FP.
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22 244 Besides, model fitness was checked using deviance and model IV with the lowest deviance
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24 245 (deviance= 6125.343) was used to identify significantly associated factors with unmet need for
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26 246 FP. Therefore, all interpretations and conclusions of results were thus being based on model IV.
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30 247 **Fixed effect model**

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32 248 After adjusting for possible confounders, age, women's education level, wealth of household,
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34 249 number of children, age at first marriage, working status, distance from the health facility,
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36 250 community husband education level, and community media exposure were significantly
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38 251 associated with unmet need for FP in Ethiopia.
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42 252 As age of women increases the odds of unmet need for FP increases (AOR=1.05; 95% CI:
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44 253 1.04,1.06). The odds of unmet need for FP among women who attend primary education was
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46 254 13% (AOR=0.87; 95% CI: 0.74,0.94) lower as compared with women with no formal education. As
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48 255 the number of children increases, the odds of unmet need for FP increases (AOR=1.15; 95% CI:
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50 256 1.07, 1.24). The working status of women also affect unmet need for FP positively (AOR=1.18;
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52 257 95% CI: 1.02,1.37). Women married at age 18 or later had 18% (AOR=0.82; 95% CI: 0.70, 0.96)
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lower odds of unmet need for FP as compared to marital age less than 18. Additionally, considering the wealth index, the odds of unmet need for FP among women from richer/richest class was 23% (AOR= 0.77; 95% CI: 0.64,0.94) lower as compared with women from the poorer/poorest class.

Among community factors, the odds of unmet for FP among women reporting distance to a health facility as not the big problem was decreased by 15% (AOR=0.85; 95% CI: 0.73, 0.99) compared with their defined counterparts. Moreover, women from communities with a high percentage of educated women (AOR=0.73; 95% CI: 0.59, 0.89) were less likely to have unmet need for FP compared with women from communities with a low percentage of educated women. Similarly, this study further reveals that women who live in communities with high media exposure were associated with decreased odds of unmet need for FP compared to women in the reference category (AOR=0.81, 95% CI: 0.68,0.98) (Table 2).

Discussion

This study was conducted to investigate the magnitude and factors for unmet need in FP among rural women in the reproductive age group. This study made contributions to the literature on unmet need for FP since it focused rural women which have high unmet for FP prevalence and has only been covered in few studies on unmet need for FP in the rural areas. Identifying specific factors associated with unmet need for family planning in a rural area has therefore been brought further to the fore of national family planning awareness and improving access to reproductive health services, as this is critical for achieving the fifth SDG goal.⁴⁷ Additionally, this study extended factors associated with unmet need for FP by considering community-level factors that

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3 279 may shape the level of unmet need for family planning in Ethiopia. This provides information on
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6 280 a wider range of factors to be targeted by family planning policymakers in the country.
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8 281 The current study revealed that 24.08% (95%CI: 23.17, 25.01) of rural women in reproductive age
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10 282 in Ethiopia had total unmet need for FP. The result is lower than a study conducted in Ethiopia,^{15–}
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12 283 ^{17,19,20} Ghana,⁴⁸ and Cameroon.¹² This discrepancy could be explained by the fact that the
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14 284 previous studies conducted in Ethiopia^{15–17,19,20} were small scale surveys compared to the EDHS
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16 285 which is a nationally representative survey and covered more women in the region. The
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18 286 discrepancy could be due to the differences in studied populations and background
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20 287 characteristics differences among participants. For example, assessing unmet need of long-
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22 288 acting and permanent family planning methods ¹⁹ and among young married women ¹⁵ in
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24 289 Ethiopia, and unmet need among HIV positive women in Ghana⁴⁸ versus assessing unmet need
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26 290 for FP among reproductive-age group women in our study. In terms of background characteristics
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28 291 differences among participants the proportion of women who were married in this study was
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30 292 98.0%, and in the Cameroon study, it was 61.1%.¹² The previous study implies that married
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32 293 women had 59% lower odds of unmet need for FP compared to never married women.¹¹
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34 294 However, the magnitude of unmet need for FP in this study was higher than a study conducted
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36 295 in Ethiopia,^{18,21} Sudan,⁴⁹ Burkina Faso,¹⁰ Malawi,¹¹ Cameroon,³⁹ and Nigeria.³⁸ This variation
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38 296 might be attributed to the differences in study population and study setting. The current study
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40 297 exclusively includes rural women. In most parts of Ethiopia, rural residents have usually low
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42 298 health services coverage and decreased awareness of FP due to low education, low
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44 299 socioeconomic status, and have limited access to FP services this may lead to a higher prevalence
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46 300 of unmet need in rural areas. Therefore, this provides information on rural residents to be
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targeted by family planning policymakers in the country because the high unmet need for FP further exposes women to unintended pregnancies and unsafe abortion, which raises the risk of maternal and child death.^{10,25,50,51} Another possible explanation for the difference in the prevalence of unmet need could be the difference in the educational level of study participants. For instance, a previous study done in Ethiopia reported that 41.6% of women have no formal education which was lower than that of this study (65.4%). Moreover, a study conducted in Sudan reveals that 51.1% of women had secondary education which was higher than that of the current study (3.6%). Previous literature documented that educational level has a negative relationship with unmet need for FP.^{11,19,20,23,33,35,37,38,40} Therefore, expansion of women's education which is currently poor as found in the current study is recommended to increase awareness and to reduce unmet need for FP among women in rural areas. A higher proportion was observed for unmet need for spacing in comparison with that for limiting (14.79% Vs 9.28%). This finding is in line with other studies conducted in different parts of Ethiopia,^{18,20,21} Sudan,⁴⁹ and Cameroon^{12,39} where unmet need for spacing contributed to a higher proportion of the total unmet need.

In this study age of women was statistically significant that as age of women increased, the magnitude of unmet need also increased. Similarly, a study conducted in Ethiopia^{15,18,20} and Malawi¹¹ reveals that unmet need for family planning was higher among older women than younger women. This could be because older women near to menopause may perceive as low risk to the pregnancy and because of near schooling period among younger creates better awareness on unmet need for FP. Older women are considered to have more children than younger women might be another possible explanation of this association.

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3 323 In this study, women’s education is another most important variable which significantly
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6 324 associated with unmet need for FP. That is women with primary education were less likely to
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8 325 report having an unmet need for FP as compared to women without education. This is congruent
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10 326 with the study conducted in Ethiopia,^{19,20,23,33,40} Nigeria,³⁸ Malawi,¹¹ Burundi,³⁵ and LMICs .³⁷ This
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13 327 might be due to women who attained education are more exposed to family planning through
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15 328 media and other modes of exposure which improves access to FP alternatives and helps them to
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18 329 understand the health benefits of the FP to reduce fertility, maternal and child morbidity and
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20 330 mortality. It suggests that educated women are more likely to gain family planning services
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23 331 because education of women makes them more empowered in decision making regarding
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25 332 contraceptive use.⁵² Furthermore, the educational status of women is directly related to
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28 333 economic and social empowerment which increased exposure to resources such as access to
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30 334 media and utilization of desired health care delivery services. Our study contradicts the finding
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33 335 of studies conducted in Ethiopia,^{21,40} Sudan,⁴⁹ Burundi,³⁵ Nigeria,³⁶ Kenya,⁵³ and Nepal,³⁴ which
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35 336 have reported educated women coincides with higher odds of unmet need for FP. These findings
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38 337 indicate that the need to take the context into account when assessing factors associated with
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40 338 unmet need for FP.
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42 339 A lower proportion of unmet need for FP was observed among women in the high wealth
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45 340 quantile. Results of this study show that women who were in the high wealth quintile were 23%
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48 341 less likely to have unmet need for FP than women who belong to the low quintile; this is in line
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50 342 with the results of other studies conducted in Ethiopia,^{21,54} Kenya,⁵³ Burundi,³⁵ Nigeria,³⁶ and
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52 343 Pakistan.²⁸ This may be due to our result reveals women in the high wealth category were most
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55 344 of them attend higher education but those in the low wealth category were most of them are

not educated. Additionally, most of the women in the high wealth category are exposed to media (54.0%) as compared with women in the low wealth category (23.7%). Education and mass media exposure could probably give women a better chance to understand the uses of family planning and the negative effects of family planning methods thereby increased their consistent use.

The current study found that women who had been working within the 12 months preceding the survey had higher odds of having unmet need for FP. This finding is supported by studies in Ethiopia²³ and Malawi¹¹. The possible explanation for this association might be because women who were working can have a good income so they may be able to afford private health facilities compared with their counterparts.⁵⁵ Moreover, women who were working would have a great deal of trust and decision-making ability on health services including FP.^{55,56}

Consistent with previous studies,^{10,17,18,34–38,53} our study indicates that unmet need for FP is positively associated with the number of children, in which an increased number of children is associated with the higher odds of unmet need for FP. Even though women with many children actually want to either delay the birth of her next child or to limit births, they are not empowered to use family planning by the socio-cultural setting in rural areas^{23,57}. Therefore, it is important to address socio-cultural barriers to reproductive health services in rural areas by strengthening the traditional governance structure, forming volunteer groups and committees, promoting male involvement in reproductive health services, engaging religious and clan leaders in reproductive health services.⁵⁸

We also identified as the first marital age increased, the level of unmet need was decreased. Women married at age 18 or later had lower odds of unmet need for FP as compared to marital age less than 18. This finding is similar to a study conducted in Enemay District and Gonji Kolela

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3 367 District, Ethiopia,^{20,59} but it disagrees with another study done in Southern Nations, Nationalities
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6 368 and Peoples Region, Ethiopia.²³ Women who marry at age 18 or later were able to plan and
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8 369 decide their family size because they had more exposure to FP methods. In addition, to increased
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11 370 unmet need for FP, child marriage (marriage before their 18th birthday) is associated with early
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13 371 childbearing of a mother, low economic status of women, termination of education,
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15 372 psychological impact, higher rates of divorce, a number of poor social and physical outcomes for
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18 373 young women and their offspring, complications of pregnancy and an increased risk of both
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20 374 maternal and child mortalities.^{60–62} This implies policymakers should strive to create awareness
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23 375 and enforce the legal age for marriage so as to increase the marital age ≥ 18 years to reduce
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25 376 unmet need for FP. However, studies on marital age has resulted in conflicting findings in
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28 377 Ethiopia. Some studies reported that marital age are negatively associated with unmet need for
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30 378 FP^{20,59}, while one study reported that marital age are positively associated with unmet need for
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32 379 FP²³. In this regard, systematic meta-analysis conducted in Ethiopia revealed that the odds of
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35 380 unmet need for FP was 2.3 times higher among women with age at first marriage < 18 years than
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37 381 women marriage at 18 years and above.⁶³
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40 382 Similar to a study conducted in Malawi ¹¹ this study found that unmet need for FP was greater
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42 383 among women who cited the distance to a health facility as a problem. This finding suggests
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45 384 improving geographical access to health facilities decreases unmet need for FP. This could be
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47 385 explained by women who live closest to health facility are more likely to receive appropriate
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49 386 maternal healthcare services..^{64–66} Previous studies reveal that women who receive maternal
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52 387 healthcare services (postnatal care and antenatal care) was significantly associated with a higher
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388 prevalence of contraception than women who did not receive any maternal healthcare
389 services.^{67,68}

390 Furthermore, the current study reveals that community-level factors were also associated with
391 the unmet need for FP. Unmet need for FP was found to be lower among women from
392 communities with a high percentage of educated husbands. This is consistent with a study
393 conducted in Malawi.¹¹ The result of our study further reveals that women who live in
394 communities with high media exposure had decreased odds of unmet need for FP. This might be
395 due to educated women having higher odds of understanding health messages and experiencing
396 demand for FP services. Additionally, educated women and women from wealthier households
397 are more likely to be empowered to make decision on their own choices which may subsequently
398 increase accessing information and affording private health facilities to access FP services.^{69,70}
399 Mass media is an important tool for mobilizing communities to use FP services.³³ Therefore,
400 women from communities with a high percentage of exposure to media and educated women
401 may learn from others about the benefit of using FP services and where these may be accessed.
402 This study builds literature on both individual and community-level factors associated with unmet
403 need for FP among rural women using EDHS. Besides, taking intervention at individual level,
404 identifying community-level factors is important to take intervention at community-level.
405 Therefore, we hope this study will help policymakers to make wise decisions to reduce unmet
406 need for FP, and it could be used as a baseline for future researchers to address limitations of
407 study.

408 **Strength and limitations**

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The main strength of this study was it used large population-based data with a large sample size, which more representative of the entire population of rural Ethiopia. Furthermore, multilevel logistic regression was applied for this study to identify the contextual factors in the occurrence of unmet need for FP among rural women of reproductive age. Despite the study's strengths, it has limitations. Due to the cross-sectional nature of the EDHS data, it does not show a temporal relationship between independent variables and outcome variable. Additionally, due to the use of secondary data essential factors such as knowledge and attitude of FP methods, fear of side effects, health worker training on FP and men’s perspectives on contraceptive use were not available in the EDHS; therefore, it was not possible to incorporate these variables in the analysis.

Conclusion

This study has shown that unmet need for family planning among reproductive-aged women in rural Ethiopia was high. Women’s age, number of children, and working status of women were significantly associated with higher odds of unmet needs for family planning. However, women with primary education, women married at age 18 or later, being higher wealth, distance to a health facility not the big problem, women from communities with a high percentage of educated women and women who live in communities with high media exposure were significantly associated with a lower odds of unmet needs for family planning. Therefore, there is the need to implement consistently effective family planning policies among rural women in Ethiopia. Moreover, public health policies and interventions that will strengthen women’s education, improve the existing strategies to increase the marital age of women, improve media exposure of women on family planning issues and increase the wealth status of households should be designed and implemented to reduce unmet need for FP in rural parts of country.

431 List of abbreviations

432 AOR: Adjusted Odds Ratio; CI: Confidence Interval; EDHS: Ethiopian Demographic and Health
433 Survey; ICC: Intraclass Correlation Coefficient; FP: Family Planning; LLR: Loglikelihood Ratio; MOR:
434 Median Odds Ratio; PCV: Proportional Change in Variance

435 Consent for publication

436 Not applicable

437 Availability of data and materials

438 The datasets used and/or analyzed during the current study is available in a public, open access
439 repository which is accessible online <http://www.dhsprogram.com>.

440 Competing interests

441 The authors declare that they have no competing interests.

442 Funding

443 The authors received no specific funding for this work.

444 Authors' contributions

445 AZA: developed the concept, reviewed literature, carried out the statistical analysis, interpreted
446 the results and prepared the manuscript. CDA: reviewed literature, involved in analysis,
447 interpretation and prepared the manuscript. Both the authors read and approved the
448 manuscript.

449 Acknowledgements

450 We would like to acknowledge Major Demographic Health and survey (DHS) program which
451 granted us the permission to use DHS data.

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Figure legend

Figure 1: Magnitude of unmet need for family planning among rural women in Ethiopia

633 **Table 1:** Background characteristics of respondents in Ethiopia, EDHS 2016

Variables	Frequency	Percent
Marital status		
Ever married	8,158	98.0
Never married	169	2.0
Education of respondent		
No education	5,449	65.4
Primary	2,497	30.0
Secondary	301	3.6
Higher	80	1.0
Educational status of husband		
No education	3,801	50.3
Primary	3,016	39.9
Secondary/above	736	9.8
Wealth index		
Low	3,863	46.4
Middle	2,005	24.1
High	2,459	29.5
Religion		
Orthodox	3,262	39.2
Protestant	1,824	21.9
Muslim	3,011	36.1
Others	230	2.8
Working status		
No	6,067	72.9
Yes	2,260	27.1
Media exposure		
No	6,729	80.2
Yes	1,598	19.8

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4	Knowledge of ovulatory cycle		
5	Knowledgeable	1,681	20.2
6			
7	Not knowledgeable	6,646	79.8
8			
9	Desired number of children		
10	<5	3,816	45.8
11			
12	≥5	4,511	54.2
13			
14	Age at marriage		
15			
16	<18 years	6,193	75.9
17			
18	≥18 years	1,964	24.1
19			
20	Prior pregnancy termination		
21	No	7,560	90.8
22			
23	Yes	767	9.2
24			
25	Child death		
26			
27	No	7,175	95.7
28			
29	Yes	372	4.3
30			
31	Distance from health facility		
32			
33	Big problem	5,106	61.3
34			
35	Not big problem	3,221	38.7
36			
37	Visited by field worker		
38			
39	No	5,859	70.4
40			
41	Yes	2,468	29.6
42			
43	Visited health facility last 12 months		
44			
45	No	6,068	72.9
46			
47	Yes	2,259	27.1
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635 **Table 2:** Multi-level logistic regression analysis for factors associated with unmet need for FP

636 among reproductive-age women in Ethiopia, EDHS 2016

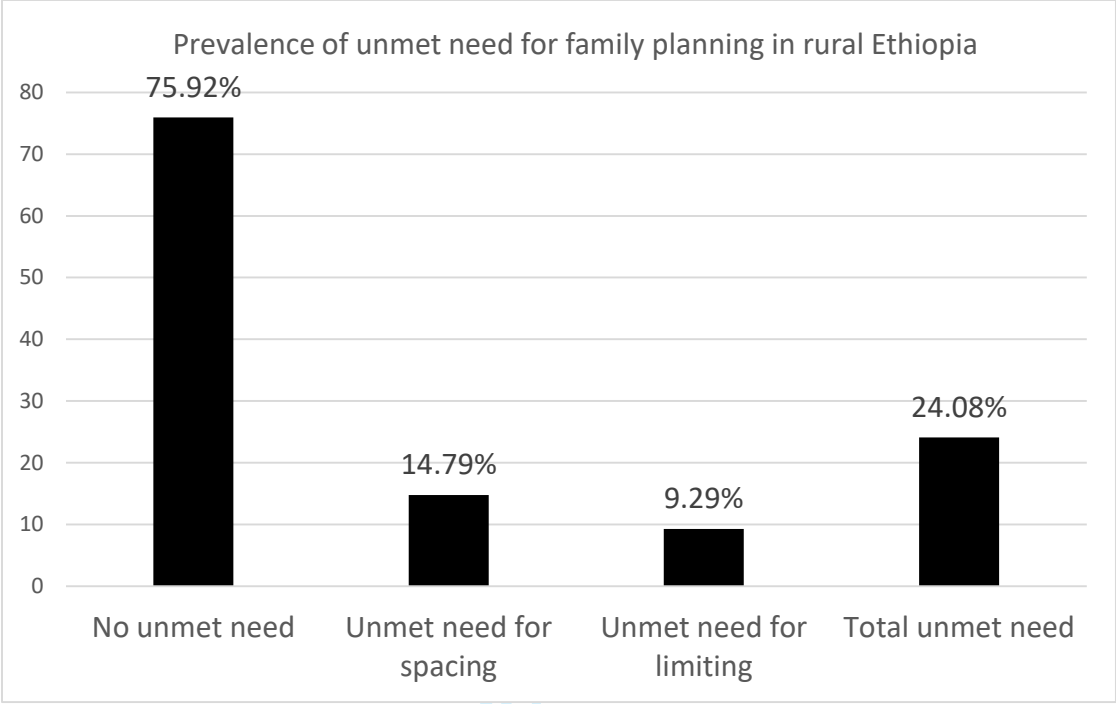
Variables	Model 1	Model 2 (AOR with 95 % CI)	Model 3 (AOR with 95 % CI)	Model 4 (AOR with 95 % CI)
Age		1.05 (1.04, 1.06)		1.05 (1.04, 1.06)*
Level of women's education				
No education		1		1
Primary		0.91 (0.80, 0.98)		0.87 (0.74, 0.94)*
Secondary		1.08 (0.71, 1.61)		1.09 (0.73, 1.64)
Higher		0.90 (0.39, 2.09)		0.91 (0.39, 2.11)
Working status of respondents				
Not working		1		1
working		1.21 (1.04, 1.40)		1.18 (1.02, 1.37)*
Type of media exposed				
No		1		1
Yes		0.87 (0.72, 1.05)		0.84 (0.69, 1.02)
Husbands' education				
No education		1		1
Primary		1.28 (1.08, 1.52)		1.23 (0.97, 1.33)
Secondary/above		1.13 (0.88, 1.44)		1.07 (0.84, 1.38)
Wealth Index				
Low		1		1
Middle		0.94 (0.78, 1.12)		0.93 (0.77, 1.11)
High		0.77 (0.64, 0.94)		0.77 (0.64, 0.94)*
Age at marriage				
<18		1		1
≥18		0.82 (0.70, 0.96)		0.82 (0.70, 0.96)*
Religion				
Orthodox		1		1
Protestant		1.08 (0.86, 1.36)		1.01(0.79, 1.2)
Muslim		1.14 (0.94, 1.38)		1.13(0.93, 1.38)

Others	1.64 (1.05, 2.56)	1.60 (1.03, 2.50)
Child death		
No	1	
Yes	1.19 (0.84, 1.69)	1.18 (0.84,1.68)
Pregnancy termination		
No	1	
Yes	0.94 (0.75, 1.17)	0.94 (0.75, 1.17)
Number of alive children	1.16 (1.07, 1.25)	1.15 (1.07, 1.24)*
Desired number of children		
<5	1	1
≥5	0.97 (0.84, 1.13)	0.99 (0.86, 1.15)
Distance from health facility		
Big problem	1	1
Not big problem	0.86 (0.76, 0.98)	0.85 (0.73, 0.99)
Community women’s education		
Low	1	1
High	0.78 (0.64, 0.93)	0.73 (0.59, 0.89)*
Community husbands’ education		
Low	1	1
High	1.17 (0.97, 1.14)	1.15 (0.94, 1.41)
Community wealth		
Low	0.83 (0.61, 1.12)	1
High		0.90 (0.66, 1.24)
Community media exposure		
Low	1	1
High	0.89 (0.75, 1.06)	0.81 (0.68, 0.98)*
Random effects and model comparison		

Community level	0.35(0.056)	0.32 (0.059)	0.30 (0.053)	0.29 (0.057)
variance (SE)				
ICC (%)	9.6	8.7	8.4	8.1
Deviance (-2LL)	7121.163	6140.094	7078.809	6125.343
PCV (%)	Ref	8.6	14.3	17.2
MOR	1.75	1.71	1.68	1.67

*P value <0.05

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Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2020-044060.R2
Article Type:	Original research
Date Submitted by the Author:	19-Mar-2021
Complete List of Authors:	Alem, Adugnaw ; University of Gondar College of Medicine and Health Sciences, Epidemiology and Bio statistics Agegnehu, Chilot; University of Gondar College of Medicine and Health Sciences, School of Nursing ;
Primary Subject Heading:	Public health
Secondary Subject Heading:	Epidemiology
Keywords:	EPIDEMIOLGY, Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Public health < INFECTIOUS DISEASES, EDUCATION & TRAINING (see Medical Education & Training)

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Magnitude and associated factors of unmet need for family planning among rural women in Ethiopia: a multilevel cross-sectional analysis

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Abstract

Objective: This study was aimed to assess the magnitude and associated factors of unmet need for family planning among rural women in Ethiopia.

Design: Cross-sectional study.

Setting: Ethiopia.

Participants: Reproductive age group women.

Primary outcome: Unmet need for family planning.

Methods: This study drew data from Ethiopian Demographic and Health Survey (EDHS), which was conducted from January 18 to June 27, 2016. A total of 8,327 rural reproductive-aged (15-49 years) women were included. A two-level multivariable logistic regression model was carried out to identify individual and community-level factors associated with unmet need for family planning. Adjusted odds ratio (AOR) with a 95% CI was used to assess the strength of association between independent and dependent variables.

Results: The overall unmet need for family planning among rural women was 24.08% (95% CI: 23.17, 25.01), of which 14.79% was for spacing and 9.29% for limiting. Number of children (AOR=1.15; 95% CI: 1.07, 1.24) and working status of women (AOR=1.18; 95% CI: 1.02,1.37) were significantly associated with a higher odds of unmet need for family planning. However, women with primary education (AOR=0.87; 95% CI: 0.74,0.94), women married at age 18 or later (AOR=0.82; 95% CI: 0.70, 0.96), women from households with high wealth index (AOR= 0.77; 95% CI: 0.64,0.94), women who deem distance to a health facility as not a big problem (AOR=0.85; 95% CI: 0.73, 0.99), women from communities with a high percentage of educated women (AOR=0.73; 95% CI: 0.59, 0.89), and women who live in communities with high media exposure (AOR=0.81, 95% CI: 0.68,0.98) were significantly associated with a lower odds of unmet needs for family planning.

Conclusion: Unmet need for family planning among reproductive-aged women in rural Ethiopia was high. Number of children, working status of women, women’s education, age at first marriage, household wealth, distance to a health facility, community women’s education, and community media exposure were significantly associated with unmet needs for family planning. Therefore, to reduce unmet need for family planning public health policymakers should consider both individual and community-level factors when designing FP programs and emphasis should be given to high-risk populations.

Keywords: Unmet need, Family planning, Rural reproductive-aged women, Ethiopia

Strength and limitation of study

- ✓ This study used nationally representative data, which was collected with standardized and validated data collection tools.

- ✓ This study used an advanced model that accounts for the correlated nature of the EDHS data in the determination of estimates.
- ✓ The cross-sectional nature of the survey does not show the temporal or causal relationship between independent variables and outcome variable.
- ✓ Additionally, due to the use of secondary data, essential factors such as knowledge and attitudes about family planning (FP) methods, fear of side effects, health worker training on FP and men's perspectives on contraceptive use were not available in the EDHS; therefore, these factors were not included in our analysis.

Background

Improving family planning (FP) access is fundamental for Sustainable Development Goal (SDG) goals achievement. It is linked to human rights, gender equality, and women's empowerment, and has an impact on maternal, newborn, child, and adolescent health.¹ Additionally, it has a role in enhancing broad socio-economic development, improving environmental preservation, and reducing poverty.^{1,2} Despite being sexually active and expressing intention to avoid pregnancy, 40.9% of women in low and middle income countries (LMICs) who don't use any contraceptive methods prefer to space or limit the number of their children.³ This indicates an unsatisfied demand for family planning, which is commonly referred to as unmet need for family planning. It refers to the percentage of fecund women who are married or living in union and thus presumed to be sexually active but are not using any family planning methods, who either want to space (when the woman would have wished to delay the birth of her next child by at least 2 years) or to limit births (woman who do not want any more children).⁴

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65 Although the Ethiopian government incorporated FP as one of the essential health services
66 provided at the community level by health extension workers, FP utilization is low.⁵ In the
67 country, the overall utilization of FP methods among women was 36% (35% were using a modern
68 method and 1% were using a traditional method).⁴

69 Unmet need for FP is a major public health concern in developing countries, particularly in sub-
70 Saharan Africa.^{6–8} In developing countries, 225 million women had unmet need for modern FP
71 methods in 2014, and 230 million women experienced unmet need for modern FP methods in
72 2019.^{6,7} The prevalence of unmet need for FP among reproductive age group women was 18.3%
73 (15.1% for spacing and 3.2% for limiting) in Burkina Faso,⁹ 21.0% (12.6% for spacing and 8.4% for
74 limiting) in Malawi,¹⁰ 46.6% (31.1% for spacing and 15.5% for limiting) in Cameroon,¹¹ and 38.9%
75 (27.5% for spacing and 12.2% for limiting) in Ghana.¹² In Ethiopia, the magnitude of overall unmet
76 need for family planning varied from 16.2% to 34.6%^{13–18} with 10.3% to 15.8 for spacing and 6.0
77 to 9.8 for limiting.^{14,18} According to the Ethiopian Demographic and Health Survey (EDHS), overall
78 unmet need for FP declined from 37% in 2000 to 22% by 2016.^{4,19} There was a significant disparity
79 in unmet need by region of residence that varied from 19.1% to 28.0% in rural areas and 7.2% to
80 15.0% in urban areas.^{4,18,19} Despite Ethiopia introducing an ambitious community health
81 program, relying on Health Extension Workers to address limited access to health services
82 including family planning in rural areas, women in rural areas have higher unmet need for FP
83 compared with women in urban areas.^{18,20} Therefore, this study investigated factors associated
84 with unmet need for FP among reproductive-age women in rural Ethiopia.

85 Unmet need for family planning reveals issues in supply and demand for family planning
86 resources that can have serious implications for women, children, the family and the society as a

whole.⁹ Reducing unmet need for family planning would significantly reduce unwanted pregnancy, unsafe abortion, closely spaced births, childbearing at a very early age, and physical abuse,^{9,21,22} all of which are considered main contributors to preventable high maternal and infant mortality in LMICs.⁹ If all women with unmet need for family planning were to use family planning, the World Health Organization (WHO) estimated that maternal mortality could be declined by one-third.²³ Moreover, in Ethiopia, if the unmet need for FP were satisfied, more than 1 million deaths of children under the age of 5 could be prevented and nearly 13,000 maternal mortalities would be avoided over a ten year period.²⁴ In addition, the use of contraceptives to regulate fertility either for child spacing or limiting childbearing is considered as an effective tool to control population growth^{10,25} and is related to higher female literacy, gender equality, and reduced poverty^{26,27}. For these reasons, responding to unmet need for family planning has become a crucial global health priority. Ethiopia has adapted sustainable 145 development goals (SDGs), including Goal 3.1 to reduce maternal mortality and Goal 146, 3.7 to ensure universal access to reproductive health services, including family planning.²⁸ Despite Ethiopia's Health Sector Development Plan's target to reduce maternal mortality to 267 per 100,000 live births by 2015, maternal mortality in the country is 412 per 100,000 live births in 2016.^{4,29} Studies have assessed factors associated with unmet need for FP including educational status of the women and their partner,^{13,25,30–35} partner attitudes towards family planning services utilization,¹⁵ frequency of healthcare provider home visits,³⁰ discussion about family planning with their partner,^{16,36} number of desired children,^{9,17,32} place of residence,^{25,31,32,35} marital status,^{10,16,37,38} previous use of family planning,¹⁴ parity,^{15,17,18,38,39} age at first marriage,¹⁴ media exposure,^{17,25,30,32,40} age,^{10,14,17,25,31,32,34,35,41} wealth index/income,^{18,25,32,38} number of living

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3 109 children,^{9,25,30,34,35,40} experience of child death,^{32,35} knowledge about contraceptive methods,⁴¹
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6 110 working status,³⁸ fear of side effects,²⁵ occupation,^{16,31} and the attitude of respondents towards
7
8 111 family planning use.³⁰ However, inconsistent results have been reported in different settings in
9
10 112 Ethiopia. For example, a study conducted in Debre Berhan town revealed that women who
11
12 113 discuss FP with their husbands were more likely to have unmet need for FP,¹⁶ while a study in
13
14 114 Shashemene town district observed that lack of discussion between partners was more likely to
15
16 115 have unmet need for FP.¹³ In addition, while number of desired children >5 were positively
17
18 116 associated with total unmet need for FP in Shire-Enda- Slassie,¹⁴ a negative association was
19
20 117 observed in Kersa District.¹⁷ These findings indicate that factors associated with the unmet need
21
22 118 to FP are area-specific in Ethiopia, which motivates to conduct this study in rural-areas at the
23
24 119 national level.
25
26 120 Unmet need for FP is also associated with household-level and community-level factors.^{10,35}
27
28 121 Although these previous studies in Ethiopia have assessed individual-level factors, community-
29
30 122 level factors remained insufficiently explored. Additionally, unmet need remains high in rural
31
32 123 areas, yet there is a scarcity of information on the factors explaining it in rural Ethiopia. Therefore,
33
34 124 understanding the factors for unmet need for FP among women residing in rural households will
35
36 125 help public health practitioners working in FP programs to the identify, implement, and evaluate
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38 126 evidence-based interventions to tackle the unmet need and expand contraception use by
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40 127 considering the effects of community characteristics.
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128 **Methods**

129 **Study design period and setting**

130 This study was a cross-sectional study conducted using secondary data collected in the 2016
131 Ethiopian Demographic and Health Survey (EDHS). The Ethiopian Demographic and Health Survey
132 (EDHS) drew nationally representative samples for the Ethiopian population, which was collected
133 from January 18, 2016, to June 27, 2016. It is the fourth Demographic and Health Survey
134 conducted in Ethiopia that includes data collected from nine regions and two administrative
135 cities. A detailed explanation of methodological strategies used in the EDHS has been outlined
136 elsewhere.⁴²

137 **Data source and extraction**

138 The study used secondary data from the Ethiopian Demographic and Health Survey (EDHS) 2016.
139 The EDHS is a nationally representative survey using a two-stage cluster sampling method. In the
140 first stage, 645 clusters (202 urban areas and 443 rural areas) were randomly selected from the
141 sampling frame (i.e. the 2007 Ethiopian population and housing census) and household listing.
142 The second stage involved a systematic selection of 18,008 households from the selected
143 clusters, of which 17,067 were occupied. Of the occupied cluster, 16,650 were successfully
144 interviewed. The information we used was related to women of reproductive ages (15-49 years).
145 A total of 15,683 eligible women were identified for the survey. Women who had never had sex,
146 were not sexually active or were infecund were excluded from this study. A total of a weighted
147 sample of 8,327 women of reproductive age were included for analysis.

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148 **Variables of study**

149 **Outcome variable**

150 The main outcome variable was the unmet need for FP, where it composed of both unmet need
151 for spacing and limiting form of unmet need. It refers to the proportion of women who desire to
152 either delay the next pregnancy or limit future pregnancies, but are not using any method of
153 contraception.^{11,35} It was a binary variable, women with unmet need for spacing or limiting were
154 recoded as “unmet need”, while those using FP methods for spacing or limiting or with no unmet
155 need were recorded as “no unmet need”.

156 **Independent variables**

157 Based on the literature, independent variables included in the analysis are broadly categorized
158 as individual and community-level factors that are associated with unmet need for FP.

159 Individual-level variables considered in the analysis were age, women’s level of education (no
160 education, primary, secondary, and higher), religion (recoded as Muslim, Orthodox, Protestant,
161 and others), education level of husband (categorized as no education, primary, and
162 secondary/higher), marital status (categorized as ever married and never married), working
163 status (not working/working), exposure to the media (categorized as “no” if there is no media
164 exposure at all and “yes” if there is media exposure to either radio, magazine/newspaper,
165 internet or television), wealth index (poorest and poorer categorized as “low”, middle
166 categorized as “middle”, and richer and richest categorized as “high”), number of living children,
167 desired number of children (categorized as <5 and ≥5), age at marriage (categorized as <18 and
168 ≥18 years), pregnancy termination (yes/no), child death (yes/no), visited by field worker at home
169 (yes/no), visited health facility last 12 months (yes/no), discussion on women's health care

(categorized as women alone, jointly, husband alone and others), and knowledge of ovulatory cycle recoded as “knowledgeable” if they correctly identified middle of menstrual cycle as fertile window and otherwise recoded as “not knowledgeable”.

Community-level factors included in the study were community wealth, community women’s educational level, community husband’s educational level, community media exposure, and perceived distance to the health facility (big problem and not a big problem). Community wealth was defined as the proportion of women in the poorest and poorer quintile. Community women’s educational level was defined as the proportion of women with a minimum of primary level of education. Community husband educational level was defined as the proportion of husbands with a minimum of primary level of education. Community media exposure was defined as the proportion of women exposed to at least one type of media, such as radio, newspaper, television, or internet. Community-level factors, namely, community wealth, community women’s educational level, community husband educational level, and community media exposure were constructed by aggregating individual-level variables into community-level variables. Each aggregated community variable was divided into low and high based on the median value since they were not normally distributed.

Statistical analysis

All statistical analysis was performed using Stata version 14.0. Sample weighting was done before doing any statistical analysis, to adjust for the non-proportional allocation of the sample to different regions and their urban and rural areas. Descriptive statistics using frequency and percentage were used to get an overview of the selected variables. Multilevel logistic regression models were used to estimate the effects of unmet need for FP factors at the two specified levels.

It allows for the estimation of valid standard errors by adjusting for the intra-cluster correlation of the outcome variable ⁴³.

Four models were fitted. Firstly, model I, the empty or unconditional model, without covariates was analyzed. This model was used to estimate the random intercept at cluster level and the variation in the odds of unmet need for FP experience between communities. Secondly, model II was constructed by adding individual-level factors. Thirdly, model III was constructed by adding community-level factors. Finally, model IV including both individual-level community-level factors was constructed. Then, the appropriate model was selected using deviance and the model with the lowest deviance was fitted to estimate the association between independent factors and unmet need for FP. In addition, the measure of variance (random effects), which is the measure of residual errors at the individual level and community variation, was reported in terms of the intra-class correlation coefficient (ICC)⁴³ and proportional change in variance (PCV).⁴⁴

Firstly, bivariable multilevel logistic regression models were fitted and all variables with a p-value < 0.20 at bi-variable analysis were entered into the multivariable analysis. Then multivariable multilevel logistic regression model was performed to control for possible confounders. In multivariable multilevel logistic regression models, odds ratios together with 95% confidence interval (CI) were calculated and statistical significance was declared at p-value <0.05.

Ethical Consideration

The data was accessed from the Demographic Health Survey Program at <http://www.dhsprogram.com>. Ethical approval was not needed because the study used publicly available data. However, permission to use the data for the study was obtained from the

213 Demographic Health Survey program. Informed consent was obtained at the beginning of each
214 interview by the EDHS data collectors.

215 **Patient and public involvement statement**

216 In this study, patients and the public were not involved in the study design or planning of the
217 study. Furthermore, as we used secondary analysis, EDHS data patients were not consulted to
218 interpret the results and were not invited to contribute to the writing or editing of this document
219 for readability or accuracy.

220 **Results**

221 In this study, a total weighted sample of 8,327 women in reproductive age was included. The
222 mean age of the study participants was 29.08 ± 7.71 years. Most of them were Orthodox ($n =$
223 3,262, 39.2%), had ever been married ($n = 8,158$, 98.0%), married before 18 years of age ($n =$
224 6,193, 75.9%), desired to have five or more children ($n = 4,511$, 54.2), and were not exposed to
225 media ($n = 6,729$, 80.2%). Regarding educational status, nearly two-third ($n = 5,449$, 65.4%) of
226 women and nearly half of their parents ($n = 3,801$, 50.3%) had no formal education (**Table 1**).

227 **Magnitude of unmet for family planning**

228 In this study overall unmet need for FP among rural women was 24.08% (95%CI: 23.17, 25.01) of
229 which 14.79% (95%CI: 14.04, 15.57) was for spacing and 9.29% (95%CI: 8.68, 9.93) for limiting
230 (**Figure 1**).

231 **Factors associated with unmet need for FP.**

232 **Random effect model**

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As presented in table 2, in the null model, about 9.6% of the total variance in the unmet need for FP was at the community level and may be attributable to other unobserved community factors (ICC = 0.096). In the final model (model IV), as indicated by the PCV, 17.2% of the variation in unmet need for FP across communities was explained by both individual and community-level factors. Additionally, the final model indicates that the lowest MOR value (1.67) which showed the effects of community heterogeneity. This means if we randomly select women from different clusters, women at the cluster with higher risk of unmet need for FP had 1.67 times higher odds of unmet need for FP as compared with those women at cluster with the lowest risk of unmet for FP. Besides, model fitness was checked using deviance and model IV with the lowest deviance (deviance= 6125.343) was used to identify significantly associated factors with unmet need for FP. Therefore, all interpretations and conclusions of results were thus based on model IV.

Fixed effect model

After adjusting for possible confounders, age, women’s education level, wealth of household, number of children, age at first marriage, working status, distance from the health facility, community husband education level, and community media exposure were significantly associated with unmet need for FP in Ethiopia.

As age of women increases the odds of unmet need for FP increases (AOR=1.05; 95% CI: 1.04,1.06). The odds of unmet need for FP among women who attend primary education was 13% (AOR=0.87; 95% CI: 0.74,0.94) lower as compared with women with no formal education. As the number of children increases, the odds of unmet need for FP increases (AOR=1.15; 95% CI: 1.07, 1.24). Women who had been working within the 12 months preceding the survey had higher odds of having unmet need for FP (AOR=1.18; 95% CI: 1.02,1.37) compared to women who

do not work. Women married at age 18 or later had 18% (AOR=0.82; 95% CI: 0.70, 0.96) lower odds of unmet need for FP as compared to marital age less than 18. Additionally, considering the wealth index, the odds of unmet need for FP among women from high wealth class was 23% (AOR= 0.77; 95% CI: 0.64,0.94) lower as compared with women from the poorer/poorest class. Among community factors, the odds of unmet for FP among women reporting distance to a health facility as not the big problem was decreased by 15% (AOR=0.85; 95% CI: 0.73, 0.99) compared with their defined counterparts. Moreover, women from communities with a high percentage of educated women (AOR=0.73; 95% CI: 0.59, 0.89) were less likely to have unmet need for FP compared with women from communities with a low percentage of educated women. Similarly, this study further reveals that women who live in communities with high media exposure were associated with decreased odds of unmet need for FP compared to women in low-media exposure communities (AOR=0.81, 95% CI: 0.68,0.98) (**Table 2**).

Discussion

This study was conducted to investigate the magnitude and factors for unmet need in FP among rural women in the reproductive age group. This study contributes to the literature on unmet need for FP by focusing on rural women, who have high unmet need for FP. Few studies of unmet need in rural areas have looked at this population. Identifying specific factors associated with unmet need for family planning in a rural area has therefore been brought further to the fore of national family planning awareness and improving access to reproductive health services, as this is critical for achieving the fifth SDG goal.⁴⁵ Additionally, this study extended factors associated with unmet need for FP by considering community-level factors that may shape the level of

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3 276 unmet need for family planning in Ethiopia. This provides information on a wider range of factors
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6 277 to be targeted by family planning policymakers in the country.
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8 278 The current study revealed that 24.08% (95%CI: 23.17, 25.01) of rural women in reproductive age
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11 279 in Ethiopia had total unmet need for FP. The result is lower than a study conducted in
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13 280 Ethiopia,^{13,15–17,46} Ghana,⁴⁷ and Cameroon.¹¹ This discrepancy could be explained by the fact that
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15 281 the previous studies conducted in Ethiopia^{13,15–17} were small scale surveys compared to the EDHS
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18 282 which is a nationally representative survey and covered more women in the region. It could be
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20 283 due to the differences in studied populations and background characteristics differences among
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22 284 participants. For example, assessing unmet need of long-acting and permanent family planning
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24 285 methods¹³ and among young married women¹⁷ in Ethiopia, and unmet need among HIV positive
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26 286 women in Ghana⁴⁷ versus assessing unmet need for FP among reproductive-age group women in
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28 287 our study. In terms of background characteristics differences among participants, the proportion
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30 288 of women who were married in this study was 98.0%, and in the Cameroon study, it was 61.1%.¹¹
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33 289 In this regard, the previous study implies that married women had 59% lower odds of unmet
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35 290 need for FP compared to never married women.¹⁰ Therefore, having large proportions of women
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37 291 who are married in our study may reduce the odds of unmet need for FP.
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40 292 However, the magnitude of unmet need for FP in this study was higher than studies conducted
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42 293 in Ethiopia,^{14,18} Burkina Faso,⁹ Malawi,¹⁰ Cameroon,³⁶ and Nigeria.³⁵ This variation might be
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44 294 attributed to the differences in study population and study setting. The current study exclusively
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46 295 includes rural women. In most parts of Ethiopia, rural residents have usually low health services
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48 296 coverage and decreased awareness of FP due to low education, low socioeconomic status, and
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50 297 have limited access to FP services this may lead to a higher prevalence of unmet need in rural
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298 areas. Therefore, this provides information on rural residents to be targeted by family planning
299 policymakers in the country because the high unmet need for FP further exposes women to
300 unintended pregnancies and unsafe abortion, which raises the risk of maternal and child
301 death.^{9,48} Another possible explanation for the difference in the prevalence of unmet need could
302 be the difference in the educational level of study participants. For instance, a previous study
303 done in Ethiopia reported that 41.6% of women have no formal education which was lower than
304 that of this study (65.4%). Moreover, a study conducted in Sudan reveals that 51.1% of women
305 had secondary education which was higher than that of the current study (3.6%). Previous
306 literature documented that educational level has a negative relationship with unmet need for
307 FP.^{10,13,30,32,34,35,37} Therefore, expansion of women's education, which is currently poor as found
308 in the current study, is recommended to increase awareness and to reduce unmet need for FP
309 among women in rural areas. Besides, empowering illiterate women to know about and use FP,
310 and its promotion of men and couples through increasing outreach in the form of household
311 visits by a community health worker may reduce unmet need for FP in rural areas.^{49,50} A higher
312 proportion was observed for unmet need for spacing in comparison with that for limiting (14.79%
313 Vs 9.28%). This finding is in line with other studies conducted in different parts of Ethiopia^{14,18}
314 and Cameroon^{11,36} where unmet need for spacing contributed to a higher proportion of the total
315 unmet need.

316 In this study age of women was statistically significant that as age of women increased, the
317 magnitude of unmet need also increased. Similarly, a study conducted in Ethiopia^{14,17} and
318 Malawi¹⁰ reveals that unmet need for family planning was higher among older women than
319 younger women. This could be because older women near to menopause may be perceived as

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low risk for pregnancy and younger women may have better awareness of FP due to recently attending school. Moreover, this association may be explained by the fact that older women tend to have higher numbers of children than younger women.

In this study, women’s education is another important variable which significantly associated with unmet need for FP. That is women with primary education were less likely to report having an unmet need for FP as compared to women without education. This is congruent with the study conducted in Ethiopia,^{13,30,37} Nigeria,³⁵ Malawi,¹⁰ Burundi,³² and other LMICs .³⁴ This might be due to women who attained education being more exposed to family planning through media and other modes of exposure, which improves access to FP alternatives and helps them to understand the health benefits of the FP to reduce fertility, maternal and child morbidity and mortality. It suggests that educated women are more likely to gain family planning services because they are more empowered in decision making regarding contraceptive use.⁵¹ Furthermore, the educational status of women is directly related to economic and social empowerment which increased exposure to resources such as access to media and utilization of desired health care delivery services. Our study contradicts the finding of studies conducted in Ethiopia,^{18,37} Burundi,³² Nigeria,³³ and Nepal,³¹ which have reported educated women have higher odds of unmet need for FP. These findings indicate that the need to take the context into account when assessing factors associated with unmet need for FP.

A lower proportion of unmet need for FP was observed among women in the high wealth quantile. Results of this study show that women who were in the high wealth quintile were 23% less likely to have unmet need for FP than women who belong to the low quintile; this is in line with the results of other studies conducted in Ethiopia,^{18,24} Burundi,³² Nigeria,³³ and Pakistan.²⁵

342 This may be due to our result reveals women in the high wealth category were most of them
343 attend higher education but those in the low wealth category were most of them are not
344 educated. Additionally, most of the women in the high wealth category are exposed to media
345 (54.0%) as compared with women in the low wealth category (23.7%). Education and mass media
346 exposure could probably give women a better chance to understand the uses of family planning
347 and the negative effects of family planning methods thereby increased their consistent use.

348 The current study found that women who had been working within the 12 months preceding the
349 survey had higher odds of having unmet need for FP. This finding is supported by study conducted
350 in Malawi ¹⁰. The possible explanation for this association might be because women who were
351 working can have a good income so they may be able to afford private health facilities compared
352 with their counterparts.⁵² Moreover, women who were working would have a great deal of trust
353 and decision-making ability on health services including FP.^{52,53}

354 Consistent with previous studies,^{9,14,15,31-35} our study indicates that unmet need for FP is
355 positively associated with having more children. Even though women with many children may
356 actually want to either delay the birth of their next child or to limit births, they are not
357 empowered to use family planning by the socio-cultural setting in rural areas ^{54,55}. Therefore, it
358 is important to address socio-cultural barriers to reproductive health services in rural areas by
359 strengthening the traditional governance structure, forming volunteer groups and committees,
360 promoting male involvement in reproductive health services and engaging religious, and clan
361 leaders in reproductive health services.⁵⁶

362 We also identified that as the first marital age increased, the level of unmet need decreased.

363 Women married at age 18 or later had lower odds of unmet need for FP compared to women

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3 364 who married before age 18. This finding is similar to study conducted in Gonji Kolela District,
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6 365 Ethiopia,⁵⁷ but it disagrees with another study done in Southern Nations, Nationalities and
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8 366 Peoples Region, Ethiopia.⁵⁴ Women who marry at age 18 or later were able to plan and decide
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10 367 their family size because they had more exposure to FP methods. In addition to increased unmet
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12 368 need for FP, child marriage (marriage before their 18th birthday) is associated with early
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14 369 childbearing, low economic status of women, termination of education, negative psychological
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16 370 impact, higher rates of divorce, a number of poor social and physical outcomes for young women
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18 371 and their offspring, complications of pregnancy and an increased risk of both maternal and child
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20 372 mortalities.^{58,59} This implies policymakers should strive to create awareness and enforce the legal
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22 373 age for marriage so as to increase the marital age above 18 years to reduce unmet need for FP.
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24 374 However, studies on marital age have resulted in conflicting findings in Ethiopia. Some studies
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26 375 reported that marital age is negatively associated with unmet need for FP^{46,57}, while one study
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28 376 reported that marital age are positively associated with unmet need for FP⁵⁴. In this regard, a
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30 377 systematic meta-analysis conducted in Ethiopia revealed that the odds of unmet need for FP was
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32 378 2.3 times higher among women with age at first marriage < 18 years than women marriage at
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34 379 18 years and above.⁶⁰
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36 380 Similar to a study conducted in Malawi,¹⁰ this study found that unmet need for FP was greater
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38 381 among women who cited the distance to a health facility as a problem. This finding suggests
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40 382 improving geographical access to health facilities decreases unmet need for FP. This could be
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42 383 explained by women who live closest to health facility being more likely to receive appropriate
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44 384 maternal healthcare services.^{61–63} Previous studies revealed that women who received maternal
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healthcare services (antenatal and postnatal care) were more likely to use contraception than women who did not receive any maternal healthcare services.^{64,65}

Furthermore, the current study reveals that community-level factors were also associated with the unmet need for FP. Unmet need for FP was found to be lower among women from communities with a high percentage of educated women. This is consistent with a study conducted in Malawi.¹⁰ The result of our study further reveals that women who live in communities with high media exposure had decreased odds of unmet need for FP compared to women in low-media exposure communities. This might be due to educated women having higher odds of understanding health messages and experiencing demand for FP services. Additionally, educated women and women from wealthier households are more likely to be empowered to make decisions on their own, which may subsequently increase accessing information and affording private health facilities to access FP services.^{66,67} Mass media is an important tool for mobilizing communities to use FP services.³⁰ Therefore, women from communities with a high percentage of exposure to media and educated women may learn from others about the benefit of using FP services and where these may be accessed.

This study builds literature on both individual and community-level factors associated with unmet need for FP among rural women using EDHS. This has implications for both interventions at the individual and community level. Therefore, we hope this study will help policymakers to make wise decisions to reduce unmet need for FP, and it could be used as a baseline measure for future family planning intervention studies.

Strength and limitations

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The main strength of this study was it used large population-based data with a large sample size, which is representative of the entire population of rural Ethiopia. Also using large sample size allows us to more precisely estimate unmet need for family planning and the effect size for associated risk factors. Furthermore, multilevel logistic regression was applied for this study to identify the contextual factors in the occurrence of unmet need for FP among rural women of reproductive age. Despite the study's strengths, it has limitations. Due to the cross-sectional nature of the EDHS data, it does not show a temporal relationship between independent variables and outcome variable. Additionally, due to the use of secondary data essential factors such as knowledge and attitude of FP methods, fear of side effects, health worker training on FP and men’s perspectives on contraceptive use were not available in the EDHS; therefore, it was not possible to incorporate these variables in the analysis.

Conclusion

This study has shown that unmet need for family planning among reproductive-aged women in rural Ethiopia was high. Number of children, and working status of women were significantly associated with higher odds of unmet needs for family planning. However, women with primary education, women married at age 18 or later, being higher wealth, distance to a health facility not the big problem, women from communities with a high percentage of educated women and women who live in communities with high media exposure were significantly associated with a lower odds of unmet needs for family planning. Therefore, there is the need to implement consistently effective family planning policies among rural women in Ethiopia. Moreover, public health policies and interventions that will strengthen women’s education, improve the existing strategies to increase the marital age of women, improve media exposure of women on family

428 planning issues and increase the wealth status of households should be designed and
429 implemented to reduce unmet need for FP in rural parts of country.

430 **List of abbreviations**

431 AOR: Adjusted Odds Ratio; CI: Confidence Interval; EDHS: Ethiopian Demographic and Health
432 Survey; ICC: Intraclass Correlation Coefficient; FP: Family Planning; LLR: Loglikelihood Ratio; MOR:
433 Median Odds Ratio; PCV: Proportional Change in Variance

434 **Consent for publication**

435 Not applicable

436 **Availability of data and materials**

437 The datasets used and/or analyzed during the current study is available in a public, open access
438 repository which is accessible online <http://www.dhsprogram.com>.

439 **Competing interests**

440 The authors declare that they have no competing interests.

441 **Funding**

442 The authors received no specific funding for this work.

443 **Authors' contributions**

444 AZA: developed the concept, reviewed literature, carried out the statistical analysis, interpreted
445 the results and prepared the manuscript. CDA: reviewed literature, involved in analysis,
446 interpretation and prepared the manuscript. Both the authors read and approved the
447 manuscript.

448 **Acknowledgements**

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3 449 We would like to acknowledge Major Demographic Health and Survey (DHS) program, which
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6 450 granted us the permission to use DHS data.
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8 451 **References**
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671 **Figure legend**672 **Figure 1:** Magnitude of unmet need for family planning among rural women in Ethiopia673 **Table 1:** Background characteristics of respondents in Ethiopia, EDHS 2016

Variables	Frequency	Percent
Marital status		
Ever married	8,158	98.0
Never married	169	2.0
Education of respondent		
No education	5,449	65.4
Primary	2,497	30.0
Secondary	301	3.6
Higher	80	1.0
Educational status of husband		
No education	3,801	50.3
Primary	3,016	39.9
Secondary/above	736	9.8
Wealth index		
Low	3,863	46.4
Middle	2,005	24.1
High	2,459	29.5
Religion		
Orthodox	3,262	39.2
Protestant	1,824	21.9
Muslim	3,011	36.1
Others	230	2.8
Working status		
No	6,067	72.9
Yes	2,260	27.1

Media exposure		
No	6,729	80.2
Yes	1,598	19.8
Knowledge of ovulatory cycle		
Knowledgeable	1,681	20.2
Not knowledgeable	6,646	79.8
Desired number of children		
<5	3,816	45.8
≥5	4,511	54.2
Age at marriage		
<18 years	6,193	75.9
≥18 years	1,964	24.1
Prior pregnancy termination		
No	7,560	90.8
Yes	767	9.2
Child death		
No	7,175	95.7
Yes	372	4.3
Distance from health facility		
Big problem	5,106	61.3
Not big problem	3,221	38.7
Visited by field worker		
No	5,859	70.4
Yes	2,468	29.6
Visited health facility last 12 months		
No	6,068	72.9
Yes	2,259	27.1

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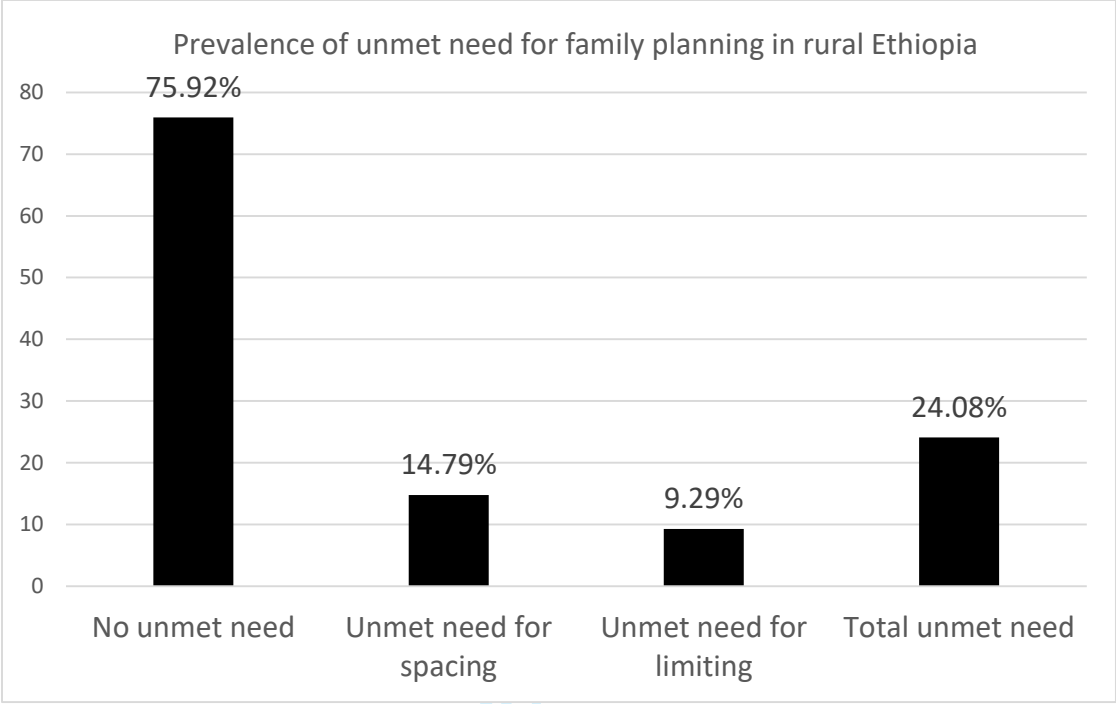
Table 2: Multi-level logistic regression analysis for factors associated with unmet need for FP among reproductive-age women in Ethiopia, EDHS 2016

Variables	Model 1	Model 2 (AOR with 95 % CI)	Model 3 (AOR with 95 % CI)	Model 4 (AOR with 95 % CI)
Age		1.05 (1.04, 1.06)		1.05 (1.04, 1.06)*
Level of women's education				
No education		1		1
Primary		0.91 (0.80, 0.98)		0.87 (0.74, 0.94)*
Secondary		1.08 (0.71, 1.61)		1.09 (0.73, 1.64)
Higher		0.90 (0.39, 2.09)		0.91 (0.39, 2.11)
Working status of respondents				
Not working		1		1
working		1.21 (1.04, 1.40)		1.18 (1.02, 1.37)*
Type of media exposed				
No		1		1
Yes		0.87 (0.72, 1.05)		0.84 (0.69, 1.02)
Husbands' education				
No education		1		1
Primary		1.28 (1.08, 1.52)		1.23 (0.97, 1.33)
Secondary/above		1.13 (0.88, 1.44)		1.07 (0.84, 1.38)
Wealth Index				
Low		1		1
Middle		0.94 (0.78, 1.12)		0.93 (0.77, 1.11)
High		0.77 (0.64, 0.94)		0.77 (0.64, 0.94)*
Age at marriage				
<18		1		1
≥18		0.82 (0.70, 0.96)		0.82 (0.70, 0.96)*
Religion				

Orthodox	1	1
Protestant	1.08 (0.86, 1.36)	1.01(0.79, 1.2)
Muslim	1.14 (0.94, 1.38)	1.13(0.93, 1.38)
Others	1.64 (1.05, 2.56)	1.60 (1.03, 2.50)
Child death		
No	1	
Yes	1.19 (0.84, 1.69)	1.18 (0.84,1.68)
Pregnancy termination		
No	1	
Yes	0.94 (0.75, 1.17)	0.94 (0.75, 1.17)
Number of alive children	1.16 (1.07, 1.25)	1.15 (1.07, 1.24)*
Desired number of children		
<5	1	1
≥5	0.97 (0.84, 1.13)	0.99 (0.86, 1.15)
Distance from health facility		
Big problem	1	1
Not big problem	0.86 (0.76, 0.98)	0.85 (0.73, 0.99)
Community women’s education		
Low	1	1
High	0.78 (0.64, 0.93)	0.73 (0.59, 0.89)*
Community husbands’ education		
Low	1	1
High	1.17 (0.97, 1.14)	1.15 (0.94, 1.41)
Community wealth		
Low	1	1
High	0.83 (0.61, 1.12)	0.90 (0.66, 1.24)
Community media exposure		
Low	1	1

High			0.89 (0.75, 1.06)	0.81 (0.68, 0.98)*
Random effects and model comparison				
Community level	0.35(0.056)	0.32 (0.059)	0.30 (0.053)	0.29 (0.057)
variance (SE)				
ICC (%)	9.6	8.7	8.4	8.1
Deviance (-2LL)	7121.163	6140.094	7078.809	6125.343
PCV (%)	Ref	8.6	14.3	17.2
MOR	1.75	1.71	1.68	1.67

*P value <0.05



BMJ Open

Magnitude and associated factors of unmet need for family planning among rural women in Ethiopia: a multilevel cross-sectional analysis

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2020-044060.R3
Article Type:	Original research
Date Submitted by the Author:	25-Mar-2021
Complete List of Authors:	Alem, Adugnaw ; University of Gondar College of Medicine and Health Sciences, Epidemiology and Bio statistics Agegnehu, Chilot; University of Gondar College of Medicine and Health Sciences, School of Nursing ;
Primary Subject Heading:	Public health
Secondary Subject Heading:	Epidemiology
Keywords:	EPIDEMIOLGY, Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Public health < INFECTIOUS DISEASES, EDUCATION & TRAINING (see Medical Education & Training)

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Magnitude and associated factors of unmet need for family planning among rural women in Ethiopia: a multilevel cross-sectional analysis

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Abstract

Objective: This study was aimed to assess the magnitude and associated factors of unmet need for family planning among rural women in Ethiopia.

Design: Cross-sectional study.

Setting: Ethiopia.

Participants: Reproductive age group women.

Primary outcome: Unmet need for family planning.

Methods: This study drew data from Ethiopian Demographic and Health Survey (EDHS), which was conducted from January 18 to June 27, 2016. A total of 8,327 rural reproductive-aged (15-49 years) women were included. A two-level multivariable logistic regression model was carried out to identify individual and community-level factors associated with unmet need for family planning. Adjusted odds ratio (AOR) with a 95% CI was used to assess the strength of association between independent and dependent variables.

Results: The overall unmet need for family planning among rural women was 24.08% (95% CI: 23.17, 25.01), of which 14.79% was for spacing and 9.29% for limiting. Number of children (AOR=1.15; 95% CI: 1.07, 1.24) and working status of women (AOR=1.18; 95% CI: 1.02,1.37) were significantly associated with a higher odds of unmet need for family planning. However, women with primary education (AOR=0.87; 95% CI: 0.74,0.94), women married at age 18 or later (AOR=0.82; 95% CI: 0.70, 0.96), women from households with high wealth index (AOR= 0.77; 95% CI: 0.64,0.94), women who deem distance to a health facility as not a big problem (AOR=0.85; 95% CI: 0.73, 0.99), women from communities with a high percentage of educated women (AOR=0.73; 95% CI: 0.59, 0.89), and women who live in communities with high media exposure (AOR=0.81, 95% CI: 0.68,0.98) were significantly associated with a lower odds of unmet needs for family planning.

Conclusion: Unmet need for family planning among reproductive-aged women in rural Ethiopia was high. Number of children, working status of women, women’s education, age at first marriage, household wealth, distance to a health facility, community women’s education, and community media exposure were significantly associated with unmet needs for family planning. Therefore, to reduce unmet need for family planning public health policymakers should consider both individual and community-level factors when designing FP programs and emphasis should be given to high-risk populations.

Keywords: Unmet need, Family planning, Rural reproductive-aged women, Ethiopia

Strength and limitation of study

- ✓ This study used nationally representative data, which was collected with standardized and validated data collection tools.

- ✓ This study used an advanced model that accounts for the correlated nature of the EDHS data in the determination of estimates.
- ✓ The cross-sectional nature of the survey does not show the temporal or causal relationship between independent variables and outcome variable.
- ✓ Additionally, due to the use of secondary data, essential factors such as knowledge and attitudes about family planning (FP) methods, fear of side effects, health worker training on FP and men's perspectives on contraceptive use were not available in the EDHS; therefore, these factors were not included in our analysis.

Background

Improving family planning (FP) access is fundamental for Sustainable Development Goal (SDG) goals achievement. It is linked to human rights, gender equality, and women's empowerment, and has an impact on maternal, newborn, child, and adolescent health.¹ Additionally, it has a role in enhancing broad socio-economic development, improving environmental preservation, and reducing poverty.^{1,2} Despite being sexually active and expressing intention to avoid pregnancy, 40.9% of women in low and middle income countries (LMICs) who don't use any contraceptive methods prefer to space or limit the number of their children.³ This indicates an unsatisfied demand for family planning, which is commonly referred to as unmet need for family planning. It refers to the percentage of fecund women who are married or living in union and thus presumed to be sexually active but are not using any family planning methods, who either want to space (when the woman would have wished to delay the birth of her next child by at least 2 years) or to limit births (woman who do not want any more children).⁴

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3 65 Although the Ethiopian government incorporated FP as one of the essential health services
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6 66 provided at the community level by health extension workers, FP utilization is low.⁵ In the
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8 67 country, the overall utilization of FP methods among women was 36% (35% were using a modern
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10 68 method and 1% were using a traditional method).⁴
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13 69 Unmet need for FP is a major public health concern in developing countries, particularly in sub-
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15 70 Saharan Africa.^{6–8} In developing countries, 225 million women had unmet need for modern FP
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17 71 methods in 2014, and 230 million women experienced unmet need for modern FP methods in
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19 72 2019.^{6,7} The prevalence of unmet need for FP among reproductive age group women was 18.3%
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21 73 (15.1% for spacing and 3.2% for limiting) in Burkina Faso,⁹ 21.0% (12.6% for spacing and 8.4% for
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23 74 limiting) in Malawi,¹⁰ 46.6% (31.1% for spacing and 15.5% for limiting) in Cameroon,¹¹ and 38.9%
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25 75 (27.5% for spacing and 12.2% for limiting) in Ghana.¹² In Ethiopia, the magnitude of overall unmet
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27 76 need for family planning varied from 16.2% to 34.6%^{13–18} with 10.3% to 15.8 for spacing and 6.0
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29 77 to 9.8 for limiting.^{14,18} According to the Ethiopian Demographic and Health Survey (EDHS), overall
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31 78 unmet need for FP declined from 37% in 2000 to 22% by 2016.^{4,19} There was a significant disparity
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33 79 in unmet need by region of residence that varied from 19.1% to 28.0% in rural areas and 7.2% to
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35 80 15.0% in urban areas.^{4,18,19} Despite Ethiopia introducing an ambitious community health
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37 81 program, relying on Health Extension Workers to address limited access to health services
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39 82 including family planning in rural areas, women in rural areas have higher unmet need for FP
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41 83 compared with women in urban areas.^{18,20} Therefore, this study investigated factors associated
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43 84 with unmet need for FP among reproductive-age women in rural Ethiopia.
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45 85 Unmet need for family planning reveals issues in supply and demand for family planning
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47 86 resources that can have serious implications for women, children, the family and the society as a
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whole.⁹ Reducing unmet need for family planning would significantly reduce unwanted pregnancy, unsafe abortion, closely spaced births, childbearing at a very early age, and physical abuse,^{9,21,22} all of which are considered main contributors to preventable high maternal and infant mortality in LMICs.⁹ If all women with unmet need for family planning were to use family planning, the World Health Organization (WHO) estimated that maternal mortality could be declined by one-third.²³ Moreover, in Ethiopia, if the unmet need for FP were satisfied, more than 1 million deaths of children under the age of 5 could be prevented and nearly 13,000 maternal mortalities would be avoided over a ten year period.²⁴ In addition, the use of contraceptives to regulate fertility either for child spacing or limiting childbearing is considered as an effective tool to control population growth^{10,25} and is related to higher female literacy, gender equality, and reduced poverty^{26,27}. For these reasons, responding to unmet need for family planning has become a crucial global health priority. Ethiopia has adapted sustainable 145 development goals (SDGs), including Goal 3.1 to reduce maternal mortality and Goal 146, 3.7 to ensure universal access to reproductive health services, including family planning.²⁸ Despite Ethiopia's Health Sector Development Plan's target to reduce maternal mortality to 267 per 100,000 live births by 2015, maternal mortality in the country is 412 per 100,000 live births in 2016.^{4,29} Studies have assessed factors associated with unmet need for FP including educational status of the women and their partner,^{13,25,30-35} partner attitudes towards family planning services utilization,¹⁵ frequency of healthcare provider home visits,³⁰ discussion about family planning with their partner,^{16,36} number of desired children,^{9,17,32} place of residence,^{25,31,32,35} marital status,^{10,16,37,38} previous use of family planning,¹⁴ parity,^{15,17,18,38,39} age at first marriage,¹⁴ media exposure,^{17,25,30,32,40} age,^{10,14,17,25,31,32,34,35,41} wealth index/income,^{18,25,32,38} number of living

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3 109 children,^{9,25,30,34,35,40} experience of child death,^{32,35} knowledge about contraceptive methods,⁴¹
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6 110 working status,³⁸ fear of side effects,²⁵ occupation,^{16,31} and the attitude of respondents towards
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8 111 family planning use.³⁰ However, inconsistent results have been reported in different settings in
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10 112 Ethiopia. For example, a study conducted in Debre Berhan town revealed that women who
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12 113 discuss FP with their husbands were more likely to have unmet need for FP,¹⁶ while a study in
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14 114 Shashemene town district observed that lack of discussion between partners was more likely to
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16 115 have unmet need for FP.¹³ In addition, while number of desired children >5 were positively
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18 116 associated with total unmet need for FP in Shire-Enda- Slassie,¹⁴ a negative association was
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20 117 observed in Kersa District.¹⁷ These findings indicate that factors associated with the unmet need
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22 118 to FP are area-specific in Ethiopia, which motivates to conduct this study in rural-areas at the
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24 119 national level.
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29 120 Unmet need for FP is also associated with household-level and community-level factors.^{10,35}
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31 121 Although these previous studies in Ethiopia have assessed individual-level factors, community-
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33 122 level factors remained insufficiently explored. Additionally, unmet need remains high in rural
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35 123 areas, yet there is a scarcity of information on the factors explaining it in rural Ethiopia. Therefore,
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37 124 understanding the factors for unmet need for FP among women residing in rural households will
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39 125 help public health practitioners working in FP programs to the identify, implement, and evaluate
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41 126 evidence-based interventions to tackle the unmet need and expand contraception use by
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43 127 considering the effects of community characteristics.
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128 **Methods**

129 **Study design, period and setting**

130 This study was a cross-sectional study conducted using secondary data collected in the 2016
131 Ethiopian Demographic and Health Survey (EDHS). The Ethiopian Demographic and Health Survey
132 (EDHS) drew nationally representative samples for the Ethiopian population, which was collected
133 from January 18, 2016, to June 27, 2016. It is the fourth Demographic and Health Survey
134 conducted in Ethiopia that includes data collected from nine regions and two administrative
135 cities. A detailed explanation of methodological strategies used in the EDHS has been outlined
136 elsewhere.⁴²

137 **Data source and extraction**

138 The study used secondary data from the Ethiopian Demographic and Health Survey (EDHS) 2016.
139 The EDHS is a nationally representative survey using a two-stage cluster sampling method. In the
140 first stage, 645 clusters (202 urban areas and 443 rural areas) were randomly selected from the
141 sampling frame (i.e. the 2007 Ethiopian population and housing census) and household listing.
142 The second stage involved a systematic selection of 18,008 households from the selected
143 clusters, of which 17,067 were occupied. Of the occupied cluster, 16,650 were successfully
144 interviewed. The information we used was related to women of reproductive ages (15-49 years).
145 A total of 15,683 eligible women were identified for the survey. Women who had never had sex,
146 were not sexually active or were infecund were excluded from this study. A total of a weighted
147 sample of 8,327 women of reproductive age were included for analysis.

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Variables of study

Outcome variable

The main outcome variable was the unmet need for FP, where it composed of both unmet need for spacing and limiting form of unmet need. It refers to the proportion of women who desire to either delay the next pregnancy or limit future pregnancies, but are not using any method of contraception.^{11,35} It was a binary variable, women with unmet need for spacing or limiting were recoded as “unmet need”, while those using FP methods for spacing or limiting or with no unmet need were recorded as “no unmet need”.

Independent variables

Based on the literature, independent variables included in the analysis are broadly categorized as individual and community-level factors that are associated with unmet need for FP.

Individual-level variables considered in the analysis were age, women’s level of education (no education, primary, secondary, and higher), religion (recoded as Muslim, Orthodox, Protestant, and others), education level of husband (categorized as no education, primary, and secondary/higher), marital status (categorized as ever married and never married), working status (not working/working), exposure to the media (categorized as “no” if there is no media exposure at all and “yes” if there is media exposure to either radio, magazine/newspaper, internet or television), wealth index (poorest and poorer categorized as “low”, middle categorized as “middle”, and richer and richest categorized as “high”), number of living children, desired number of children (categorized as <5 and ≥5), age at marriage (categorized as <18 and ≥18 years), pregnancy termination (yes/no), child death (yes/no), visited by field worker at home (yes/no), visited health facility last 12 months (yes/no), discussion on women's health care

(categorized as women alone, jointly, husband alone and others), and knowledge of ovulatory cycle recoded as “knowledgeable” if they correctly identified middle of menstrual cycle as fertile window and otherwise recoded as “not knowledgeable”.

Community-level factors included in the study were community wealth, community women’s educational level, community husband’s educational level, community media exposure, and perceived distance to the health facility (big problem and not a big problem). Community wealth was defined as the proportion of women in the poorest and poorer quintile. Community women’s educational level was defined as the proportion of women with a minimum of primary level of education. Community husband educational level was defined as the proportion of husbands with a minimum of primary level of education. Community media exposure was defined as the proportion of women exposed to at least one type of media, such as radio, newspaper, television, or internet. Community-level factors, namely, community wealth, community women’s educational level, community husband educational level, and community media exposure were constructed by aggregating individual-level variables into community-level variables. Each aggregated community variable was divided into low and high based on the median value because they were not normally distributed.

Statistical analysis

All statistical analysis was performed using Stata version 14.0. Sample weighting was done before doing any statistical analysis, to adjust for the non-proportional allocation of the sample to different regions and their urban and rural areas as well as to adjust for the non-response rates. Sample-based nonresponse adjustments distributed the base weights of the non-respondents to the respondents so that the sum of the adjusted weights over the responding units equals the

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sum of the base weights for responding units and non- responding units. Descriptive statistics using frequency and percentage were used to get an overview of the selected variables. Multilevel logistic regression models were used to estimate the effects of unmet need for FP factors at the two specified levels. It allows for the estimation of valid standard errors by adjusting for the intra-cluster correlation of the outcome variable ⁴³. Four models were fitted. Firstly, model I, the empty or unconditional model, without covariates was analyzed. This model was used to estimate the random intercept at cluster level and the variation in the odds of unmet need for FP experience between communities. Secondly, model II was constructed by adding individual-level factors. Thirdly, model III was constructed by adding community-level factors. Finally, model IV including both individual-level community-level factors was constructed. Then, the appropriate model was selected using deviance and the model with the lowest deviance was fitted to estimate the association between independent factors and unmet need for FP. In addition, the measure of variance (random effects), which is the measure of residual errors at the individual level and community variation, was reported in terms of the intra-class correlation coefficient (ICC)⁴³ and proportional change in variance (PCV).⁴⁴ Firstly, bivariable multilevel logistic regression models were fitted and all variables with a p-value < 0.20 at bi-variable analysis were entered into the multivariable analysis. Then multivariable multilevel logistic regression model was performed to control for possible confounders. In multivariable multilevel logistic regression models, odds ratios together with 95% confidence interval (CI) were calculated and statistical significance was declared at p-value <0.05.

Ethical Consideration

The data was accessed from the Demographic Health Survey Program at <http://www.dhsprogram.com>. Ethical approval was not needed because the study used publicly available data. However, permission to use the data for the study was obtained from the Demographic Health Survey program. Informed consent was obtained at the beginning of each interview by the EDHS data collectors.

Patient and public involvement statement

In this study, patients and the public were not involved in the study design or planning of the study. Furthermore, as we used secondary analysis, EDHS data patients were not consulted to interpret the results and were not invited to contribute to the writing or editing of this document for readability or accuracy.

Results

In this study, a total weighted sample of 8,327 women in reproductive age was included. The mean age of the study participants was 29.08 ± 7.71 years. Most of them were Orthodox (n = 3,262, 39.2%), had ever been married (n = 8,158, 98.0%), married before 18 years of age (n = 6,193, 75.9%), desired to have five or more children (n = 4,511, 54.2), and were not exposed to media (n = 6,729, 80.2%). Regarding educational status, nearly two-third (n = 5,449, 65.4%) of women and nearly half of their parents (n = 3,801, 50.3%) had no formal education (**Table 1**).

Magnitude of unmet for family planning

In this study overall unmet need for FP among rural women was 24.08% (95%CI: 23.17, 25.01) of which 14.79% (95%CI: 14.04, 15.57) was for spacing and 9.29% (95%CI: 8.68, 9.93) for limiting (**Figure 1**).

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Factors associated with unmet need for FP.

Random effect model

As presented in table 2, in the null model, about 9.6% of the total variance in the unmet need for FP was at the community level and may be attributable to other unobserved community factors (ICC = 0.096). In the final model (model IV), as indicated by the PCV, 17.2% of the variation in unmet need for FP across communities was explained by both individual and community-level factors. Additionally, the final model indicates that the lowest MOR value (1.67) which showed the effects of community heterogeneity. This means if we randomly select women from different clusters, women at the cluster with higher risk of unmet need for FP had 1.67 times higher odds of unmet need for FP as compared with those women at cluster with the lowest risk of unmet for FP. Besides, model fitness was checked using deviance and model IV with the lowest deviance (deviance= 6125.343) was used to identify significantly associated factors with unmet need for FP. Therefore, all interpretations and conclusions of results were thus based on model IV.

Fixed effect model

After adjusting for possible confounders, age, women’s education level, wealth of household, number of children, age at first marriage, working status, distance from the health facility, community husband education level, and community media exposure were significantly associated with unmet need for FP in Ethiopia.

As age of women increases the odds of unmet need for FP increases (AOR=1.05; 95% CI: 1.04,1.06). The odds of unmet need for FP among women who attend primary education was 13% (AOR=0.87; 95% CI: 0.74,0.94) lower as compared with women with no formal education. As the number of children increases, the odds of unmet need for FP increases (AOR=1.15; 95% CI:

1.07, 1.24). Women who had been working within the 12 months preceding the survey had higher odds of having unmet need for FP (AOR=1.18; 95% CI: 1.02,1.37) compared to women who do not work. Women married at age 18 or later had 18% (AOR=0.82; 95% CI: 0.70, 0.96) lower odds of unmet need for FP as compared to marital age less than 18. Additionally, considering the wealth index, the odds of unmet need for FP among women from high wealth class was 23% (AOR= 0.77; 95% CI: 0.64,0.94) lower as compared with women from the poorer/poorest class. Among community factors, the odds of unmet for FP among women reporting distance to a health facility as not the big problem was decreased by 15% (AOR=0.85; 95% CI: 0.73, 0.99) compared with their defined counterparts. Moreover, women from communities with a high percentage of educated women (AOR=0.73; 95% CI: 0.59, 0.89) were less likely to have unmet need for FP compared with women from communities with a low percentage of educated women. Similarly, this study further reveals that women who live in communities with high media exposure were associated with decreased odds of unmet need for FP compared to women in low-media exposure communities (AOR=0.81, 95% CI: 0.68,0.98) (Table 2).

Discussion

This study was conducted to investigate the magnitude and factors for unmet need in FP among rural women in the reproductive age group. This study contributes to the literature on unmet need for FP by focusing on rural women, who have high unmet need for FP. Few studies of unmet need in rural areas have looked at this population. Identifying specific factors associated with unmet need for family planning in a rural area has therefore been brought further to the fore of national family planning awareness and improving access to reproductive health services, as this is critical for achieving the fifth SDG goal.⁴⁵ Additionally, this study extended factors associated

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with unmet need for FP by considering community-level factors that may shape the level of unmet need for family planning in Ethiopia. This provides information on a wider range of factors to be targeted by family planning policymakers in the country.

The current study revealed that 24.08% (95%CI: 23.17, 25.01) of rural women in reproductive age in Ethiopia had total unmet need for FP. The result is lower than a study conducted in Ethiopia,^{13,15–17,46} Ghana,⁴⁷ and Cameroon.¹¹ This discrepancy could be explained by the fact that the previous studies conducted in Ethiopia^{13,15–17} were small scale surveys compared to the EDHS which is a nationally representative survey and covered more women in the region. It could be due to the differences in studied populations and background characteristics differences among participants. For example, assessing unmet need of long-acting and permanent family planning methods¹³ and among young married women¹⁷ in Ethiopia, and unmet need among HIV positive women in Ghana⁴⁷ versus assessing unmet need for FP among reproductive-age group women in our study. In terms of background characteristics differences among participants, the proportion of women who were married in this study was 98.0%, and in the Cameroon study, it was 61.1%.¹¹ In this regard, the previous study implies that married women had 59% lower odds of unmet need for FP compared to never married women.¹⁰ Therefore, having large proportions of women who are married in our study may reduce the odds of unmet need for FP.

However, the magnitude of unmet need for FP in this study was higher than studies conducted in Ethiopia,^{14,18} Burkina Faso,⁹ Malawi,¹⁰ Cameroon,³⁶ and Nigeria.³⁵ This variation might be attributed to the differences in study population and study setting. The current study exclusively includes rural women. In most parts of Ethiopia, rural residents have usually low health services coverage and decreased awareness of FP due to low education, low socioeconomic status, and

300 have limited access to FP services this may lead to a higher prevalence of unmet need in rural
301 areas. Therefore, this provides information on rural residents to be targeted by family planning
302 policymakers in the country because the high unmet need for FP further exposes women to
303 unintended pregnancies and unsafe abortion, which raises the risk of maternal and child
304 death.^{9,48} Another possible explanation for the difference in the prevalence of unmet need could
305 be the difference in the educational level of study participants. For instance, a previous study
306 done in Ethiopia reported that 41.6% of women have no formal education which was lower than
307 that of this study (65.4%). Moreover, a study conducted in Sudan reveals that 51.1% of women
308 had secondary education which was higher than that of the current study (3.6%). Previous
309 literature documented that educational level has a negative relationship with unmet need for
310 FP.^{10,13,30,32,34,35,37} Therefore, expansion of women's education, which is currently poor as found
311 in the current study, is recommended to increase awareness and to reduce unmet need for FP
312 among women in rural areas. Besides, empowering illiterate women to know about and use FP,
313 and its promotion of men and couples through increasing outreach in the form of household
314 visits by a community health worker may reduce unmet need for FP in rural areas.^{49,50} A higher
315 proportion was observed for unmet need for spacing in comparison with that for limiting (14.79%
316 Vs 9.28%). This finding is in line with other studies conducted in different parts of Ethiopia^{14,18}
317 and Cameroon^{11,36} where unmet need for spacing contributed to a higher proportion of the total
318 unmet need.

319 In this study age of women was statistically significant that as age of women increased, the
320 magnitude of unmet need also increased. Similarly, a study conducted in Ethiopia^{14,17} and
321 Malawi¹⁰ reveals that unmet need for family planning was higher among older women than

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3 322 younger women. This could be because older women near to menopause may be perceived as
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6 323 low risk for pregnancy and younger women may have better awareness of FP due to recently
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8 324 attending school. Moreover, this association may be explained by the fact that older women tend
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11 325 to have higher numbers of children than younger women.
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13 326 In this study, women’s education is another important variable which significantly associated
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15 327 with unmet need for FP. That is women with primary education were less likely to report having
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18 328 an unmet need for FP as compared to women without education. This is congruent with the study
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20 329 conducted in Ethiopia,^{13,30,37} Nigeria,³⁵ Malawi,¹⁰ Burundi,³² and other LMICs .³⁴ This might be
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23 330 due to women who attained education being more exposed to family planning through media
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25 331 and other modes of exposure, which improves access to FP alternatives and helps them to
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28 332 understand the health benefits of the FP to reduce fertility, maternal and child morbidity and
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30 333 mortality. It suggests that educated women are more likely to gain family planning services
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32 334 because they are more empowered in decision making regarding contraceptive use.⁵¹
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35 335 Furthermore, the educational status of women is directly related to economic and social
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37 336 empowerment which increased exposure to resources such as access to media and utilization of
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40 337 desired health care delivery services. Our study contradicts the finding of studies conducted in
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42 338 Ethiopia,^{18,37} Burundi,³² Nigeria,³³ and Nepal,³¹ which have reported educated women have
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45 339 higher odds of unmet need for FP. These findings indicate that the need to take the context into
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47 340 account when assessing factors associated with unmet need for FP.
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50 341 A lower proportion of unmet need for FP was observed among women in the high wealth
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52 342 quantile. Results of this study show that women who were in the high wealth quintile were 23%
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55 343 less likely to have unmet need for FP than women who belong to the low quintile; this is in line

with the results of other studies conducted in Ethiopia,^{18,24} Burundi,³² Nigeria,³³ and Pakistan.²⁵

This may be due to our result reveals women in the high wealth category were most of them attend higher education but those in the low wealth category were most of them are not educated. Additionally, most of the women in the high wealth category are exposed to media (54.0%) as compared with women in the low wealth category (23.7%). Education and mass media exposure could probably give women a better chance to understand the uses of family planning and the negative effects of family planning methods thereby increased their consistent use.

The current study found that women who had been working within the 12 months preceding the survey had higher odds of having unmet need for FP. This finding is supported by study conducted in Malawi¹⁰. The possible explanation for this association might be because women who were working can have a good income so they may be able to afford private health facilities compared with their counterparts.⁵² Moreover, women who were working would have a great deal of trust and decision-making ability on health services including FP.^{52,53}

Consistent with previous studies,^{9,14,15,31–35} our study indicates that unmet need for FP is positively associated with having more children. Even though women with many children may actually want to either delay the birth of their next child or to limit births, they are not empowered to use family planning by the socio-cultural setting in rural areas^{54,55}. Therefore, it is important to address socio-cultural barriers to reproductive health services in rural areas by strengthening the traditional governance structure, forming volunteer groups and committees, promoting male involvement in reproductive health services and engaging religious, and clan leaders in reproductive health services.⁵⁶

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We also identified that as the first marital age increased, the level of unmet need decreased. Women married at age 18 or later had lower odds of unmet need for FP compared to women who married before age 18. This finding is similar to study conducted in Gonji Kolela District, Ethiopia,⁵⁷ but it disagrees with another study done in Southern Nations, Nationalities and Peoples Region, Ethiopia.⁵⁴ Women who marry at age 18 or later were able to plan and decide their family size because they had more exposure to FP methods. In addition to increased unmet need for FP, child marriage (marriage before their 18th birthday) is associated with early childbearing, low economic status of women, termination of education, negative psychological impact, higher rates of divorce, a number of poor social and physical outcomes for young women and their offspring, complications of pregnancy and an increased risk of both maternal and child mortalities.^{58,59} This implies policymakers should strive to create awareness and enforce the legal age for marriage so as to increase the marital age above 18 years to reduce unmet need for FP. However, studies on marital age have resulted in conflicting findings in Ethiopia. Some studies reported that marital age is negatively associated with unmet need for FP^{46,57}, while one study reported that marital age are positively associated with unmet need for FP⁵⁴. In this regard, a systematic meta-analysis conducted in Ethiopia revealed that the odds of unmet need for FP was 2.3 times higher among women with age at first marriage < 18 years than women marriage at 18 years and above.⁶⁰ Similar to a study conducted in Malawi,¹⁰ this study found that unmet need for FP was greater among women who cited the distance to a health facility as a problem. This finding suggests improving geographical access to health facilities decreases unmet need for FP. This could be explained by women who live closest to health facility being more likely to receive appropriate

maternal healthcare services.^{61–63} Previous studies revealed that women who received maternal healthcare services (antenatal and postnatal care) were more likely to use contraception than women who did not receive any maternal healthcare services.^{64,65}

Furthermore, the current study reveals that community-level factors were also associated with the unmet need for FP. Unmet need for FP was found to be lower among women from communities with a high percentage of educated women. This is consistent with a study conducted in Malawi.¹⁰ The result of our study further reveals that women who live in communities with high media exposure had decreased odds of unmet need for FP compared to women in low-media exposure communities. This might be due to educated women having higher odds of understanding health messages and experiencing demand for FP services. Additionally, educated women and women from wealthier households are more likely to be empowered to make decisions on their own, which may subsequently increase accessing information and affording private health facilities to access FP services.^{66,67} Mass media is an important tool for mobilizing communities to use FP services.³⁰ Therefore, women from communities with a high percentage of exposure to media and educated women may learn from others about the benefit of using FP services and where these may be accessed.

This study builds literature on both individual and community-level factors associated with unmet need for FP among rural women using EDHS. This has implications for both interventions at the individual and community level. Therefore, we hope this study will help policymakers to make wise decisions to reduce unmet need for FP, and it could be used as a baseline measure for future family planning intervention studies.

Strength and limitations

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The main strength of this study was it used large population-based data with a large sample size, which is representative of the entire population of rural Ethiopia. Also using large sample size allows us to more precisely estimate unmet need for family planning and the effect size for associated risk factors. Furthermore, multilevel logistic regression was applied for this study to identify the contextual factors in the occurrence of unmet need for FP among rural women of reproductive age. Despite the study's strengths, it has limitations. Due to the cross-sectional nature of the EDHS data, it does not show a temporal relationship between independent variables and outcome variable. Additionally, due to the use of secondary data essential factors such as knowledge and attitude of FP methods, fear of side effects, health worker training on FP and men's perspectives on contraceptive use were not available in the EDHS; therefore, it was not possible to incorporate these variables in the analysis.

Conclusion

This study has shown that unmet need for family planning among reproductive-aged women in rural Ethiopia was high. Number of children, and working status of women were significantly associated with higher odds of unmet needs for family planning. However, women with primary education, women married at age 18 or later, being higher wealth, distance to a health facility not the big problem, women from communities with a high percentage of educated women and women who live in communities with high media exposure were significantly associated with a lower odds of unmet needs for family planning. Therefore, there is the need to implement consistently effective family planning policies among rural women in Ethiopia. Moreover, public health policies and interventions that will strengthen women's education, improve the existing strategies to increase the marital age of women, improve media exposure of women on family

431 planning issues and increase the wealth status of households should be designed and
432 implemented to reduce unmet need for FP in rural parts of country.

433 **List of abbreviations**

434 AOR: Adjusted Odds Ratio; CI: Confidence Interval; EDHS: Ethiopian Demographic and Health
435 Survey; ICC: Intraclass Correlation Coefficient; FP: Family Planning; LLR: Loglikelihood Ratio; MOR:
436 Median Odds Ratio; PCV: Proportional Change in Variance

437 **Consent for publication**

438 Not applicable

439 **Availability of data and materials**

440 The datasets used and/or analyzed during the current study is available in a public, open access
441 repository which is accessible online <http://www.dhsprogram.com>.

442 **Competing interests**

443 The authors declare that they have no competing interests.

444 **Funding**

445 The authors received no specific funding for this work.

446 **Authors' contributions**

447 AZA: developed the concept, reviewed literature, carried out the statistical analysis, interpreted
448 the results and prepared the manuscript. CDA: reviewed literature, involved in analysis,
449 interpretation and prepared the manuscript. Both the authors read and approved the
450 manuscript.

451 **Acknowledgements**

We would like to acknowledge Major Demographic Health and Survey (DHS) program, which granted us the permission to use DHS data.

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674 **Figure legend**675 **Figure 1:** Magnitude of unmet need for family planning among rural women in Ethiopia676 **Table 1:** Background characteristics of respondents in Ethiopia, EDHS 2016

Variables	Frequency	Percent
Marital status		
Ever married	8,158	98.0
Never married	169	2.0
Education of respondent		
No education	5,449	65.4
Primary	2,497	30.0
Secondary	301	3.6
Higher	80	1.0
Educational status of husband		
No education	3,801	50.3
Primary	3,016	39.9
Secondary/above	736	9.8
Wealth index		
Low	3,863	46.4
Middle	2,005	24.1
High	2,459	29.5
Religion		
Orthodox	3,262	39.2
Protestant	1,824	21.9
Muslim	3,011	36.1
Others	230	2.8
Working status		
No	6,067	72.9
Yes	2,260	27.1

Media exposure		
No	6,729	80.2
Yes	1,598	19.8
Knowledge of ovulatory cycle		
Knowledgeable	1,681	20.2
Not knowledgeable	6,646	79.8
Desired number of children		
<5	3,816	45.8
≥5	4,511	54.2
Age at marriage		
<18 years	6,193	75.9
≥18 years	1,964	24.1
Prior pregnancy termination		
No	7,560	90.8
Yes	767	9.2
Child death		
No	7,175	95.7
Yes	372	4.3
Distance from health facility		
Big problem	5,106	61.3
Not big problem	3,221	38.7
Visited by field worker		
No	5,859	70.4
Yes	2,468	29.6
Visited health facility last 12 months		
No	6,068	72.9
Yes	2,259	27.1

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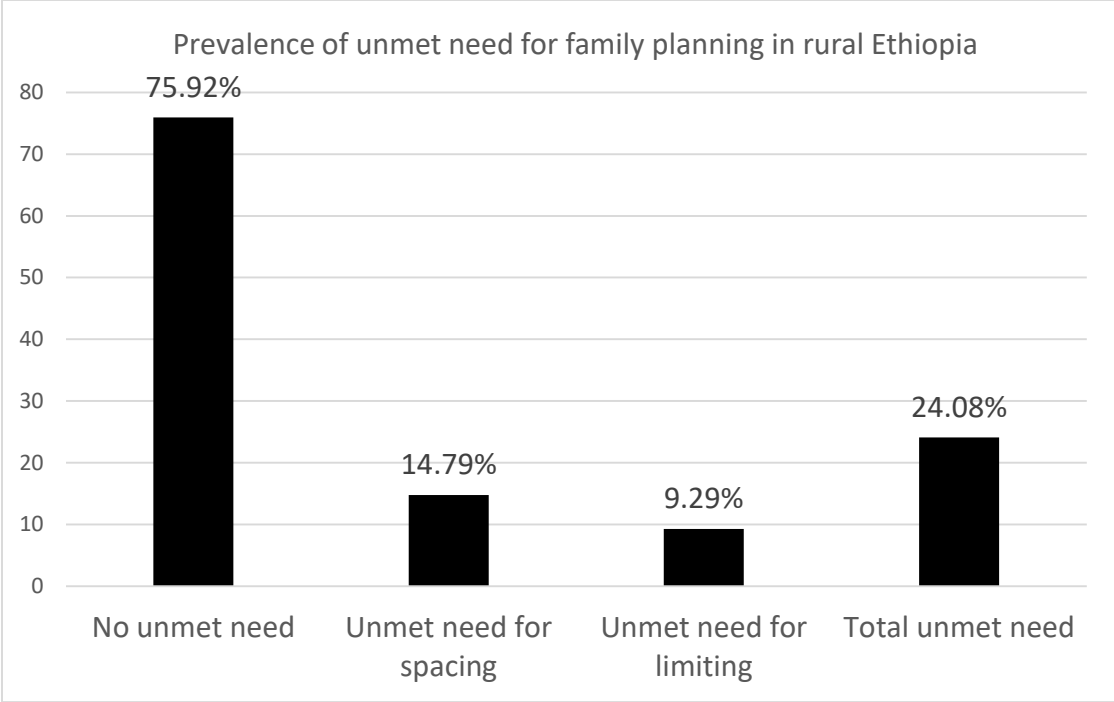
Table 2: Multi-level logistic regression analysis for factors associated with unmet need for FP among reproductive-age women in Ethiopia, EDHS 2016

Variables	Model 1	Model 2 (AOR with 95 % CI)	Model 3 (AOR with 95 % CI)	Model 4 (AOR with 95 % CI)
Age		1.05 (1.04, 1.06)		1.05 (1.04, 1.06)*
Level of women's education				
No education		1		1
Primary		0.91 (0.80, 0.98)		0.87 (0.74, 0.94)*
Secondary		1.08 (0.71, 1.61)		1.09 (0.73, 1.64)
Higher		0.90 (0.39, 2.09)		0.91 (0.39, 2.11)
Working status of respondents				
Not working		1		1
working		1.21 (1.04, 1.40)		1.18 (1.02, 1.37)*
Type of media exposed				
No		1		1
Yes		0.87 (0.72, 1.05)		0.84 (0.69, 1.02)
Husbands' education				
No education		1		1
Primary		1.28 (1.08, 1.52)		1.23 (0.97, 1.33)
Secondary/above		1.13 (0.88, 1.44)		1.07 (0.84, 1.38)
Wealth Index				
Low		1		1
Middle		0.94 (0.78, 1.12)		0.93 (0.77, 1.11)
High		0.77 (0.64, 0.94)		0.77 (0.64, 0.94)*
Age at marriage				
<18		1		1
≥18		0.82 (0.70, 0.96)		0.82 (0.70, 0.96)*
Religion				

Orthodox	1	1
Protestant	1.08 (0.86, 1.36)	1.01(0.79, 1.2)
Muslim	1.14 (0.94, 1.38)	1.13(0.93, 1.38)
Others	1.64 (1.05, 2.56)	1.60 (1.03, 2.50)
Child death		
No	1	
Yes	1.19 (0.84, 1.69)	1.18 (0.84,1.68)
Pregnancy termination		
No	1	
Yes	0.94 (0.75, 1.17)	0.94 (0.75, 1.17)
Number of alive children	1.16 (1.07, 1.25)	1.15 (1.07, 1.24)*
Desired number of children		
<5	1	1
≥5	0.97 (0.84, 1.13)	0.99 (0.86, 1.15)
Distance from health facility		
Big problem	1	1
Not big problem	0.86 (0.76, 0.98)	0.85 (0.73, 0.99)
Community women’s education		
Low	1	1
High	0.78 (0.64, 0.93)	0.73 (0.59, 0.89)*
Community husbands’ education		
Low	1	1
High	1.17 (0.97, 1.14)	1.15 (0.94, 1.41)
Community wealth		
Low	1	1
High	0.83 (0.61, 1.12)	0.90 (0.66, 1.24)
Community media exposure		
Low	1	1

High			0.89 (0.75, 1.06)	0.81 (0.68, 0.98)*
Random effects and model comparison				
Community level	0.35(0.056)	0.32 (0.059)	0.30 (0.053)	0.29 (0.057)
variance (SE)				
ICC (%)	9.6	8.7	8.4	8.1
Deviance (-2LL)	7121.163	6140.094	7078.809	6125.343
PCV (%)	Ref	8.6	14.3	17.2
MOR	1.75	1.71	1.68	1.67

*P value <0.05



STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	1 & 2
Introduction			3-6
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4-6
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			7-10
Study design	4	Present key elements of study design early in the paper	7
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	7
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	8 & 9
Data sources/measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	8 & 9
Bias	9	Describe any efforts to address potential sources of bias	-
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Not applicable
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	9 & 10
		(b) Describe any methods used to examine subgroups and interactions	Not Applicable
		(c) Explain how missing data were addressed	-
		(d) If applicable, describe analytical methods taking account of sampling strategy	Not applicable
		(e) Describe any sensitivity analyses	Not Applicable
Results			11-13
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility,	11

		confirmed eligible, included in the study, completing follow-up, and analysed	
		(b) Give reasons for non-participation at each stage	Not Applicable
		(c) Consider use of a flow diagram	Not Applicable
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	11
		(b) Indicate number of participants with missing data for each variable of interest	-
Outcome data	15*	Report numbers of outcome events or summary measures	11
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	12 & 13
		(b) Report category boundaries when continuous variables were categorized	7
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Not Applicable
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Not Applicable
Discussion			13-20
Key results	18	Summarise key results with reference to study objectives	13 & 14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	20
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	14-19
Generalizability	21	Discuss the generalisability (external validity) of the study results	20
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	21

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.