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# Impacts of inequalities in utilization of key maternal health service on fertility preference among high parity women in four selected regions of Ethiopia

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## Abstract

**Background** Fertility is one of the three main components which determines the size, structure, and composition of a population, and fertility preferences are important measures for forecasting fertility levels of a population. Therefore, this study aims to assess the impacts of the inequalities in the utilization of key maternal health services on fertility preference among high parity women in four selected regions (i.e., Afar, Beninshangul-Gumuz, Gambella and Somali) of Ethiopia.

**Methods** The study used data collected for the 2016 Ethiopian Demographic and Health Surveys (EDHS) survey. It includes a total of 977 high parity women (104 urban and 873 rural) residing in the four regions of the study. Bivariate logistic regression was used to select the potential variables by using a cut off p-value < 0.2 and then the multivariable logistic regression analyses were performed to assess the association between the selected explanatory variables (i.e., control and exposure variables) and the outcome variable (i.e. fertility preference). Further, the study employed a Population Attributable Fractions (PAFs) to examine the population level impacts of the inequalities in maternal and child health service variables on fertility preference.

**Results** The results showed that religion, household wealth index, place of delivery and contraceptive use were significantly associated with fertility preference. The results of the PAFs analysis indicated that contraceptive use had the biggest impact (80%), meaning that non-use of contraceptive increased fertility preference among women in the four regions. Similarly, out of health facility delivery increased fertility preference by 37%.

**Conclusion** The study findings underscore the critical factors influencing women's fertility preferences in the studied regions. Low utilization of maternal health services had an impact on fertility preference, accounting for more than half of the observed variations in fertility preferences. To address this issue, targeted interventions are recommended: enhancing access to maternal health services, strengthening fertility control programs, promoting the benefits of using these services, and actively addressing inequalities.

**Keywords** ANC, Decomposition, Ethiopia, Fertility preference, Inequality, Place of delivery, PNC, PAF

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## Background

Maternal health is the health of women during pregnancy, childbirth, and in the post-partum period [1]. Maternal health has been becoming a global concern because the lives of millions of women in reproductive age can be saved through maternal health care services [2, 3]. The key maternal health services include antenatal care (ANC), delivery care, postnatal care (PNC) and family planning (contraceptive) services. Recent studies indicated that nearly all pregnant women in developed countries who have low fertility, experience greater access to the key maternal health care services like ANC and delivery care. Contrary to this, women in low- and middle-income countries (LMICs) have high fertility and poor utilization of maternal health services [3–5].

Antenatal care (ANC) is also used by health providers as an opportunity to promote the use of skilled attendance at birth, the exciting family planning options, healthy life style changes, benefit for optimal pregnancy spacing, and benefit of child limiting [6, 7].Health facility delivery also another opportunity to provide information after delivery including the exciting family planning options and providing counseling about birth spacing. Countries with high rates of female contraceptive use typically have lower fertility rates [8]. Further, the studies also show that contraceptive utilization has an impact on fertility behavior [9].

Fertility is one of the three main components which determine the size, structure, and composition of a population. In three decades, the global fertility rate dropped from 3.2 live births per woman in 1990 to 2.3 in the year 2021. In similar manner, the Sub-Saharan Africa Total Fertility Rate (TFR) dropped from 6.3 births per woman in 1990 to 4.6 in 2021 [5]. Among all regions in the world, the Sub-Sharan Africa is well known for its highest fertility level [5]. Fertility preferences are important measures for forecasting fertility, calculating levels of unwanted or mistimed birth, and assessing unmet need for contraceptives [10].

Ethiopia is one of the Sub-Saharan Africa countries experiencing a fast population growth and has the highest fertility rate in the region [5, 11]. The TFR of Ethiopia in 1990 was 6.9 birth per-women which declined to 4.3 children per woman in the year 2019 [11]. In Ethiopia, there is a huge spatial variation in TFR by place of residence (such as regional and rural-urban differentials). For instance, the total fertility rate (TFR) in Somali region was 6.4 children per woman, a region known for the highest TFR [11].

Despite pro-poor health policies in Ethiopia, maternal, neonatal, and child health services utilization remains a challenge. The study done by Alem, and colleagues assessed inequality in the utilization of various maternal and child health services. Findings revealed that maternal health services were low and unevenly distributed, favoring better-off women particularly skilled birth attendance. In contrast, preventive child health services were evenly distributed. Ethiopia aims for universal and equitable use of health services. The other studies done by Alem et al., examined the association between household wealth, and maternal education with the utilization of maternal and child health services. The results indicated that higher household wealth was linked to an increased likelihood of skilled birth assistance during delivery and full child immunization. Furthermore, women's education demonstrated a positive association solely with skilled birth assistance during delivery. Educated women were more likely to receive skilled attendance during childbirth, particularly within more wealthy households. Alem et al., also done a qualitative exploratory study which highlighted inequality in MCH service utilization. Education played a significant role; educated individuals were more likely to seek timely care. Addressing educational disparities is crucial for improving maternal and child health services. These studies emphasize the need for targeted interventions to bridge gaps in health service utilization, especially among vulnerable populations in Ethiopia [12–14].

According to the 2016 Ethiopian Demographic and Health Survey (EDHS) report, 36.7% of currently married women in Ethiopia either desire no more children or have undergone sterilization at the national level. In the study regions, we find that the proportions of mothers who wanted no more children were as follows: 12.4% in Afar, 7.9% in Somali, 35.1% in Benishangul-Gumuz, and 30.7% in Gambella [15].

Several socio-demographic characteristics affect fertility preference such as age, marital status, income, household wealth, employment, educational level, parity, place of residence (urban-rural), region, religion, and number of children ever born, partners preference, sex preference for children [10, 16, 17]. Inequalities in the utilization of health services are among the most critical public health concerns in low-income economies. Despite modest progress in service utilization, significant inequality persists both within and between countries (WHO, 2010). Studies also indicated the existence of inequalities among various population groups (such as rural vs. urban, educated vs. less educated…etc.) in the utilization of maternal health services in Ethiopia [18, 19].

The 2019 Ethiopian Mini Demographic and Health Survey, though conducted in relatively smaller sample size, indicates the key maternal health services utilization in Ethiopia was very low. i.e., the percentage of ANC utilization with the recommended $4^{+}$ visits was 43%, women's delivered in a health facility was 47.5%, women's who attended a postnatal checkup during the first 2 days after their birth were 33.8% and 41.4% of women were found

as users of any one method of contraceptive [20]. Further, there is also a regional inequality in the utilization of the key maternal health services in Ethiopia. For those regions included in this study; the key maternal health services utilization was reported as; ANC service utilization (at least four times during pregnancy) was 28.3% in Afar, 23% in Somali, 31.8% in Gambella and 55.9% in Benishangul Gumuz. This indicates except Benishangul Gumuz all of the remining three regions had a lower utilization of ANC service in reference to the national average (43%) [20].

The percentage of the health facility delivery was 28.3% in Afar, 23% in Somali, 63.7% in Benishangul Gumuz and 70.3% Gambela, indicating that the health facility delivery in Afar and Somali regions were lower than the national average. The prevalence of postnatal checkup during the first 2 days after birth was 23% in Afar, 10.3% in Somali, 45% in Benishangul Gumuz, and 55% in Gambella. This suggests that Gambella and Benishangul Gumuz had a higher utilization of the PNC service compared to the other study regions and with the national average (33.8%). However, the current contraceptive use ratees in all of the study regions were lower than the national average 41.4%) i.e., only 12.7% in Afar, 3.4% in Somali, 38.5% in Benishangul Gumuz and 33.8% in Gambella were using any one of the contraceptive methods [20].

Ethiopia needs to provide effective health interventions to reduce fertility level and achieve the Sustainable Development Goals by 2030. It is important to understand how inequalities in receiving maternal health services affect fertility preferences at the population level. However, little attention has been paid to the impact of inequalities in maternal health service on fertility preference in the four study regions, where women have lower access to services and higher fertility levels. Previous studies on this topic have mainly focused on estimating prevalence, determinants, and geographical variation [21–24].

Therefor our study fills the gap in the research on the population level attribution of maternal services to fertility preferences in four selected regions of Ethiopia. Moreover, the study has a methodological contribution/relevance by using Population Attributable Fractions (PAF) to measure inequalities and population level impacts of service utilization, which are rarely used in large scale data. In addition, understanding the fertility preferences among women with high parity contributes to improved reproductive health outcomes. By informing targeted interventions, promoting reproductive autonomy, and bridging the gap between expressed desires and contraceptive practices, we empower individual decision-making. Therefore, the study aims to assess the impacts of inequalities in the utilization of key maternal health services on fertility preference among high parity women in the study regions (Afar, Benishangul Gumuz, Gambella and Somali regions of Ethiopia). The study warrants primarily to answer the question "*How much is the proportional reduction in fertility preference attributable to Maternal health service utilization in the four regions of Ethiopia*".

## Methods

### The study setting

Ethiopia is a federal democratic republic country composed of eleven national regional states and two chartered administrative cities. Among them, the four regional states of Ethiopia (Afar, Beninshangul-Gumuz, Gambella and Somali) signify a considerable part of the country's most underdeveloped parts. According to the Ethiopian Statistics Service (ESS) projection, the size of the Ethiopia population by July 2022 was 123.4 million, of which, those residing in the four regions comprised 2.51 million in Somali, 2.03 million in Afar, 1.22 million in Benishangul-Gumuz and 508 thousands in Gambella [25].

The aforementioned-four regions of Ethiopia are known by relatively new administrations which needs further support to align their capacity to the standards required and practiced by those relatively developed regional states and chartered administrative cities of the country. Further, those four regions have a common characteristics that includes; relatively slow underlying pace of development in several sectors including the development of the basic infrastructures, long-standing disputes which are commonly shaped by several factors including their being peripheral in location, the existence of inequities in levels of development across all regions, the volatility and influx of refugees from bordering countries, all situated in a areas where Ethiopia shares a country border with its neighboring countries, they are prone and commonly encounters unforeseen natural phenomena's like recurrent drought and flooding, having multiple ethnic groups, weak governance, and limited social services [26–28].

#### *Data source and sampling*

This study utilized a secondary data collected for 2016 Ethiopia Demographic and Health Surveys (EDHS). The EDHS is a nationally representative data that provides up-to-date estimates of key demographic and health indicators for Ethiopia. Among other things; the EDHS data also includes information on maternal health services, fertility, knowledge and utilization of contraception… etc. The EDHS employed a two-stage stratified sampling technique i.e., a total of 645 Enumeration Areas (EAs) were selected in the first stage and a fixed 28 households per EA were selected in the second stage. The main criteria of selecting the respondent was *"All women in the age group 15 to 49 years who permanently lived or visitors*

*and who stayed the night before the survey and were available during the survey".* Further, five different DHS Program's standard questionnaires were adopted and used during EDHS. Therefore, the current study only included married women with at least five births during the five years prior to the survey. It was determined that 977 women (aged 15 to 49) in total (104 from urban and 873 from rural) met the eligible criteria for the analysis. Figure 1 shows the detail of the selection processes of the respondents for this study.

**Outcome variables**

The outcome variable of the study is fertility preference. The information on fertility preference was collected in the Demographic and Health Surveys by asking married women whether they want more children or not. The responses included "have another", "undecided", "no-more", "sterilized (respondent or partner)", "declared fecund" and "never had sex". For the purposes of this study, we re-classified responses into a dichotomous response as 0=no which includes responses of those married women's that includes "no-more", "sterilized

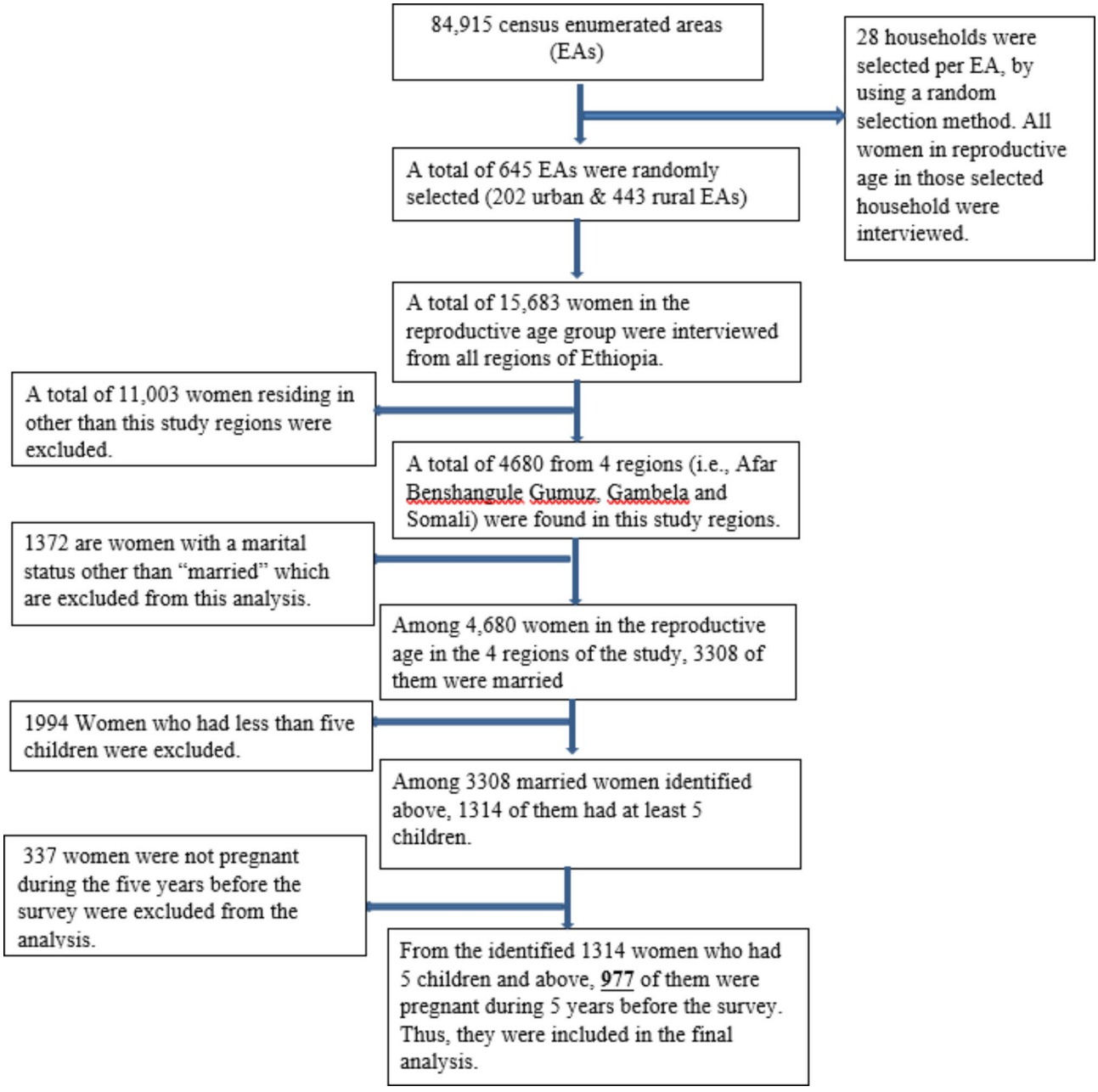


**Fig. 1** Schematic presentation of the sampling procedure

(respondent or partner)", "declared fecund" and "never had sex" and 1=yes (have preference) which includes "have another" and "undecided" [29, 30]. Ethiopia has a very high total fertility rate (4.3 births per woman) [11]. High fertility is define as having five or more children by a women over her reproductive period [31]. In addition, the study also denoted high fertility in reference to the national average. Therefore, this study included women with high fertility, who reported having five and more children during the survey period.

### Exposure and control variables

The main exposure variables we wanted to measure the impacts on the outcome variable were the key maternal health service utilization variables (ANC, place of delivery, PNC, and contraception utilization). Socio demographic variables were used as a control variables, i.e. they were used as confounding variables in the analysis so that examining the net effects of the MHS variables is possible.Table 1 summarizes the list and description of exposure and control variables included in the study.

### Statistical analysis

For data cleaning and analysis, a statistical software called Stata v-17 [32] and SPSS v-25 [33] were used. The analysis of this study followed four steps: univariate (descriptive), bivariate and multivariable logistic regression, and computation of Population Attributable Fractions (PAFs)

**Table 1** Description of exposure and control variables

| **Exposure variables** | | |
|---|---|---|
| **Name of variables** | **Variable Description** | **Coding** |
| ANC | Health care during pregnancy 5 years before the survey. | 1. < 4<br>2. > = 4 |
| Place of delivery | Births by place of delivery 5 years before the survey. | 1. Out of Health facility<br>2. Health facility |
| PNC | Care given to the women after delivery 5 years before the survey. | 1. No<br>2. Yes |
| Current use of contraceptive | Use of any medicines, devices, or surgery to prevent pregnancy. | 1. Not Using<br>2. Using |
| **Control variables** | | |
| **Name of variables** | **Variable Description** | **Coding** |
| Women age | Age in completed years. | 1. 15–19<br>2. 20–34<br>3. 35–49. |
| Husband/partner education level /women educational level | Women or men aged 15–49 by highest level of schooling attended or completed. | 1.No education<br>2.Primary education,<br>3. Secondary & above |
| Residence | Place of residence is the type of place where the respondent resides. | 1.Urban<br>2. Rural |
| Household size | The number of persons in a household. | 1.<=5,<br>2.>6 |
| Work status | Women/husband employed in the 12 months before the survey. | 1.Not working<br>2. working |
| Women autonomy on their own-health care | Women's ability and freedom to make independent decisions about their medical care. | 1. No(women with her husband / her husband/ others)<br>2- Yes (by her own ) |
| Wealth Index | Composite measure of a household's cumulative living standard measured by ownership of key assets. | 1.Poorest<br>2. Poorer<br>3.Midle<br>4.Richer<br>5.Richest |
| Religion | Religion could be based on self-identification, affiliation, beliefs, practices, or other indicators of religious involvement of the respondent. | 1. Muslim<br>2. orthodox,<br>3. protestant<br>4. Other |
| Husband desire for more children | Husband wants to have more kids. | 1. want more<br>2. others |

analysis. Bivariate logistic regression was used to select the potential variables by using a cut off p-values < 0.2 and then the multivariable logistic regression analyses were performed to assess the association between the main exposure variables and the outcome variable (i.e. fertility preference), controlling for the possible effects of the confounding variables.

To check possible multicollinearity among the independent variables, the study used Variable Inflation Factor (VIF) and those which showed a VIF values > 2.5 were excluded from further analysis. In this regard, the preliminary analysis result indicated that there was significant multicollinearity among region, religion, husband age and women age variables. Therefore, the study excluded two potential predictors (women age and region) from the logistic regression analysis. For multivariable logistic regression analysis, a p-value < 0.05 with 95% confidence interval were used to declare statistical significant associations. To select the best fitting model, we used the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC). Further, we applied regression-based Population Attributable Fractions (PAFs) which is considered as a reliable method in measuring population level impacts of interventions or risk factors [34].

PAF works under four major assumptions. It primarily assumes causality, which is a causal relationship between a specific exposure (such as a risk factor) and a disease or adverse condition. It implies that the exposure contributes to the occurrence of the desired outcome Second; PAF assumes that other risk factors are unaffected when estimating the fraction of cases attributable to a specific exposure. Multiple risk factors often interact, and their effects may not be independent. Ignoring shared causal responsibility or multicausality can lead to misinterpretations of PAFs. The third assumption is realistic intervention which indicates PAF provides insights into the potential impact of reducing exposure to a risk factor. It assumes that interventions are feasible and can realistically reduce exposure. In summary, PAF informs research priorities and guides public policies by quantifying the proportion of disease burden attributable to specific risk factors [35].

Greenland and Drescher [36] introduced the methods of obtaining Attributable Fractions directly from logistic regression analysis. In this study, we adopted the steps identified by Simon Ruckinger et al. (2009) to calculate the PAF of the risk factor of interest [34].

**Step I** The risk factor must be coded dichotomously. It is 'removed' from the population by classifying all individuals as unexposed, irrespective of their real status.

**Step II** The predicted probabilities for each-individual estimated by using this modified dataset with the below formula:

$$pp_i = \frac{1}{1 + \exp\left(-\left(\alpha + \beta' x_i\right)\right)}$$

Where α is the estimate for the intercept of the logistic regression model, $\beta$ represents the parameter vector for the covariates included in the model, and $x_i$ representing the observations of the covariates for everyone, however, with the 'removed' covariate set to zero for all individuals.

**Step III** The sum of all predicted probabilities is the adjusted number of cases of the fertility preference that would be expected if the risk factor was absent in the population.

**Step IV** The PAF is finally calculated by subtracting these expected cases from the observed cases and dividing by the observed cases.

Further, employing a combination of Population Attributable Fractions (PAFs) and multivariable logistic regression to measure inequality in maternal health services (MHS) utilization is believed to add up to the robustness of the findings. PAFs quantify the proportion of health outcomes attributable to specific risk factors, indirectly revealing inequality across different population groups. Meanwhile, multivariable logistic regression models consider multiple risk factors simultaneously, adjusting for confounders and showing how these factors impact distinct subgroups. By estimating PAFs directly from logistic regression results, we gain context-specific insights into risk factor impacts within specific populations, informing targeted interventions and addressing health inequalities.

## Results

### Back ground characteristics of respondent

Table 2 summarizes the characteristics of the 977 respondent drawn from the four regions (Afar, Benishangul Gumuz, Gambella and Somali). Most respondents were residing in the rural areas (89.4%) and the remaining 10.6% of them resided in urban areas. Most of the respondents of the study (47.6%) were in the age group 24–34 years. Majority (88.4%) of women had no education. Most of the women were living in poorest households (70%). About 75% of the respondents were Muslim and 74% were not working during the survey period.

### Bivariate relationship between socio demographic variables and fertility preference

Table 3 presents the results of the chi-square analysis and the percentage distribution of fertility preferences of married women in the four regions of Ethiopia by the selected characteristics and key maternal health service variables. The results revealed that women who resided in all of the age groups had a higher proportion of fertility

**Table 2** Background characteristics of women with high parity in four regions of Ethiopia ($n=977$)

| Characteristics | Number | Percent |
|---|---|---|
| **Region** | | |
| Afar | 236 | 24.2 |
| Somali | 388 | 39.7 |
| Benishangul Gumuz | 225 | 23.0 |
| Gambela | 128 | 13.1 |
| **Type of place of residence** | | |
| Rural | 873 | 89.4 |
| Urban | 104 | 10.6 |
| **Women age** | | |
| <=24 | 106 | 10.8 |
| 25–34 | 465 | 47.6 |
| >34 | 406 | 41.6 |
| **Education level** | | |
| No education | 864 | 88.4 |
| Primary | 93 | 9.5 |
| Secondary and above | 20 | 2.0 |
| **Household wealth status** | | |
| Poorest | 684 | 70.0 |
| Poorer | 103 | 10.5 |
| Middle | 56 | 5.7 |
| Richer | 66 | 6.8 |
| Richest | 68 | 7.0 |
| **Religion** | | |
| Muslim | 737 | 75.4 |
| Orthodox | 66 | 6.8 |
| Protestant | 138 | 14.1 |
| Others | 36 | 3.7 |
| **Work status** | | |
| No | 723 | 74.0 |
| Yes | 254 | 26.0 |
| Total | 977 | 100 |

preference, and also a gradual decline in fertility preference also observed when we go from the early to late reproductive age groups, i.e., 92.9% of those women who were in the age of 24 years and less, 81.3% from the main childbearing ages, and 67.2% of women whose age is greater than and equal to 34 years had fertility preference. The proportion of fertility preference was higher among those in no education category compared to women with primary, secondary, and above education status, respectively. Larger proportion (82%) of women from Muslim religion had higher fertility preference.

Further, the result in Table 3 also showed women's fertility preferences based on the key maternal health services (ANC, place of delivery, PNC, and current contraceptive use). About 78% of women who attended ANC services below the recommended 4 visits, 77.3% of women who delivered out of health facilities, and 78.4% of women who did not use any contraceptives had a higher proportion of fertility preference.

### Multivariable logistic regression model for investigating the impact of key maternal health service on fertility preference

Table 4 shows that religion, household wealth status, place of delivery, and current contraceptive use have a significant association with fertility preference in the four study regions. The results reveal that women who delivered at health facilities had 41% lower odds of fertility preference (AOR: 0.59; 95% CI: 0.04 to 0.36; $P<0.05$) than women who delivered out of health facilities. Moreover, the results in Table 4 show that women who are currently using contraceptives had 71% lower odds of fertility preference (AOR: 0.19; 95% CI: 0.00 to 0.10; $P<0.05$) than women who are not using contraceptives.

### Population attributable fraction (PAFs) for selected risk factor of fertility preference

The results displayed in Table 5 shows the Population-Attributed Fractions (PAFs), which is an impact measurement of an individual risk factor at the population level. Due to the small proportion of non-fertility preferences among women residing in those four regions of the study, the PAFs were computed only for women who had fertility preferences. The estimated adjusted PAFs indicate that current contraceptive use contributed the biggest proportion (80%) of impacts. This is interpreted as the proportion of fertility preference among women residing in the four regions that could have been reduced at the population level if the exposure (the non-use of contraceptives) had been removed. Similarly, 38% of the fertility preferences of women in the four regions of Ethiopia can be reduced if in the women residing in the poor households were removed. Further, 37% of the fertility preferences of women can also be reduced if the exposure to non-health facility delivery was removed. Moreover, the other socio-demographic factors, including religion and type of place of residence, were also important risk factors whose combined impact at the population level is close to 64%. The combined population-level impacts of all the significant risk factors amounted to 219%.

## Discussion

This study has primarily aimed to determine the impacts of the inequalities in utilization of key maternal health services on fertility preference among high-parity women in four regions of Ethiopia (Afar, Benishangul Gumuz, Gambella, and Somali regions). The study employed both the conventional regression analysis and PAF analysis to understand the role of the exposure variables on women's fertility preference. The first level of analysis, showed the existence of a significant association between a range of predictors (both exposure and control variables) and the dependent variable (fertility preference). The second level of analysis using PAF

**Table 3** Result of bivariate relationship between socioeconomic variables, key maternal health service and fertility preference(*N* = 977)

| Characteristics | Fertility preference | | $\chi^2$(*P* value ) |
|---|---|---|---|
| | No<br>Number and % | Yes<br>Number and % | |
| Women age | | | |
| <=24 | 1(7.1) | 13(92.9) | **< 0.001** |
| 24–34 | 92(18.7) | 401(81.3) | |
| >=34 | 154(32.8) | 316(67.2) | |
| Women Education Level | | | |
| No education | 200(23.1) | 664(76.9) | **< 0.001** |
| Primary | 39(41.9) | 54(58.1) | |
| Secondary and above | 8 ( 40.0) | 12(60.0) | |
| Religion | | | |
| Muslim | 131(17.8) | 606(82.2) | **< 0.001** |
| Orthodox | 42(63.6) | 24(36.4) | |
| Protestant | 59(42.8) | 79(57.2) | |
| Others | 15(41.7) | 21(58.3) | |
| Region | | | |
| Afar | 33(14.0) | 203(86.0) | **< 0.001** |
| Somali | 44(11.3) | 344(88.7) | |
| Benishangul Gumuz | 120(53.3) | 10546.7) | |
| Gambela | 50(39.1) | 78(60.9) | |
| Type of place of residence | | | |
| Rural | 220(25.2) | 653(74.8) | 0.47 |
| Urban | 27(26.0) | 77(74.0) | |
| Work status | | | |
| No | 159(22.0) | 564(78.0) | **< 0.001** |
| Yes | 88(34.6) | 166(65.4) | |
| Women autonomy on their health care | | | |
| No | 186(24.3) | 581(75.7) | **0.09** |
| Yes (by hear own ) | 61(29.0) | 149(71.0) | |
| Husband age | | | |
| <=34 | 20(18.9) | 86(81.1) | **0.02** |
| 35–44 | 106(22.8) | 359(77.2) | |
| > 45 | 121(29.9) | 285(70.2) | |
| Husband education | | | |
| No education | 151(21.3) | 559(78.7) | **< 0.001** |
| Primary | 60(35.5) | 108(64.3) | |
| Secondary and above | 36(36.4) | 63(63.6) | |
| Wealth index | | | |
| Poorest | 129(18.9) | 555(81.1) | **< 0.001** |
| Poorer | 34(33.0) | 69(67.7) | |
| Middle | 26(46.45) | 30(53.6) | |
| Richer | 34(51.5) | 32(48.5) | |
| Richest | 24(35.3) | 64.7) | |
| Household size | | | |
| <=5 | 20(20.4) | 78(79.6) | 0.24 |
| >=6 | 227(25.8) | 652(74.2) | |
| Husband desire for more children | | | |
| want more children | 85(23.4) | 278(76.6) | 0.32 |
| others | 161(26.3) | 452(73.7) | |
| ANC | | | |
| < 4 | 182(22.3) | 633(77.7) | **< 0.001** |
| >=4 | 65(40.1) | 97(59.9) | |
| Place of delivery | | | |

**Table 3** (continued)

| Characteristics | Fertility preference | | $\chi^2$(*P* value ) |
|---|---|---|---|
| | No<br>Number and % | Yes<br>Number and % | |
| Out of health facility | 186(22.7) | 633(77.3) | **< 0.001** |
| At health Facility | 61(38.6) | 97(61.4) | |
| PNC | | | |
| No | 214(24.4) | 662(75.6) | 0.07 |
| Yes | 21.9) | 68(67.3) | |
| Current contraceptive use | | | |
| Not using | 197(21.6) | 714(78.4) | **< 0.001** |
| Using | 50(75.8) | 16(24.2) | |
| Total | 247 | 730 | |

documented the impacts of the inequalities in the key exposure variables on the outcome variable.

Among the background characteristics used in this study, religion and wealth index were found to have significant associations with fertility preference. i.e., non-Muslim women had a lower desire to have more children compared to Muslim women. This finding is consistent with the results of previous study conducted among two Muslim communities in Kenya and in Ghana, both of which reported that Muslim women prefer red to have more children compared to Christians. The reason reported was that the respondents strongly believed that children are blessing of God [16–37].

This study also found that women who had better wealth status had lower fertility preferences compared to those living in the poorest (lowest) wealth category. This finding is in line with the results of some previous studies which indicated that higher socioeconomic status is associated with lower fertility preferences [16, 39, 40]. The possible explanations for this finding may correspond to the fact that women in the lowest wealth quintile have a greater desire to have more children as most of them believe in the utility of children as old age security i.e., it is a customary practice/expectation that most children will support their family when they grow older. In addition, in most developing countries like Ethiopia, women from the poorest families may not get the opportunity to go to school or they are poorly educated which may, by itself, hinder them from having good knowledge of family planning or reproductive [40, 41].

The contraceptive use and place of delivery had significant associations with fertility preferences. This finding is consistent with other previous studies which indicated that women who use contraception have a lower preference to have more children than those who are not using a contraceptive [39, 40]. Tessema et al. (2020) and Tessema & Tamirat, (2020) reported place of delivery as a key determinant of fertility preference of women in Ethiopia. The possible reason for such association could be skilled health professionals usually provide counseling service on FP choices and birth interval or spacing between births [22, 23]. Furthermore, those women may have a more negative subjective birth experience and an emergency operative mode of delivery (instrumental vaginal delivery or emergency cesarean delivery) which may also related to a change in fertility intentions in their postpartum period i.e., desiring fewer children and/or increasing desired inter-pregnancy interval [42].

Further, the study also analyzed the risk factors or population level impacts using the PAFs analysis. The findings confirmed that the three socioeconomic variables (religion, type of place of residence and wealth index) and the two key maternal health service (place of delivery and current contraceptive use) posed significant impacts on women's fertility preference. The PAF result in this study exceeded 100%, suggesting that some of the women had multiple risk factors that affected their fertility preference. These risk factors with fertility preference could be prevented by different methods, and the prevention cases of these women could be counted more than once [43].

The combined PAFs of the two main maternal health services (place of delivery and current contraceptive use) in this study were 117%. This means that more than half of the women's fertility preferences in this study could have been prevented by removing the risk factors (i.e., ensuring access to those nonusers of the services). The other half could also be prevented by addressing the risk factors identified from the socioeconomic variables. As previous studies indicated, the PAF results for a specific population may not be fitting or consistent to the PAF results done in other populations, since there might be a varying prevalence of risk factors [34]. This makes comparison of PAF results across different population.

This study has several strengths, such as the use of a nationally representative dataset that helps to make sound generalizations of the findings. It also has a methodological contribution/ relevance as it addressed population-level impacts of service utilization using Population Attributable Fractions (PAF), which is rarely reported by previous studies. Thus, the findings of the study can serve as one of the few references for similar studies in the future. However, this study also has some limitations. First, the study used a cross-sectional design that limits the inference of causality.

**Table 4** Multivariable binary logistic regression analysis for examining the effects of key maternal health services on fertility preference in four regions of Ethiopia (*N* = 977)

| Variables | Model1 (Control variables only) | | | | Model 2 (Control and exposure variables) | | | |
|---|---|---|---|---|---|---|---|---|
| | AOR | *P* value | 95%CI | | AOR | *P* value | 95%CI | |
| Women education level | | | | | | | | |
| Not educated [RC] | | | | | | | | |
| Primary | 0.73 | 0.23 | 0.44 | 1.22 | 0.75 | 0.28 | 0.44 | 1.28 |
| Secondary and above | 1.03 | 0.95 | 0.36 | 2.96 | 0.96 | 0.94 | 0.33 | 2.84 |
| Religion | | | | | | | | |
| Muslim [RC] | | | | | | | | |
| Orthodox | 0.16 | 0.00 | 0.09 | 0.28 | 0.19 | 0.00 | 0.11 | 0.36 |
| protestant | 0.33 | 0.00 | 0.22 | 0.52 | 0.34 | 0.00 | 0.21 | 0.53 |
| Others | 0.28 | 0.00 | 0.14 | 0.56 | 0.31 | 0.00 | 0.15 | 0.64 |
| Women autonomy on their own health care | | | | | | | | |
| No [RC] | | | | | | | | |
| Yes | 0.75 | 0.13 | 0.52 | 1.08 | 0.72 | 0.09 | 0.49 | 1.05 |
| Working status | | | | | | | | |
| No [RC] | | | | | | | | |
| Yes | 0.88 | 0.47 | 0.62 | 1.25 | 0.92 | 0.66 | 0.64 | 1.33 |
| Husband education level | | | | | | | | |
| Not educated [RC] | | | | | | | | |
| Primary | 0.93 | 0.73 | 0.61 | 1.42 | 1.06 | 0.79 | 0.68 | 1.66 |
| Secondary and above | 0.89 | 0.68 | 0.51 | 1.55 | 0.99 | 0.96 | 0.55 | 1.75 |
| Wealth index combined | | | | | | | | |
| Poorest [RC] | | | | | | | | |
| Poorer | 0.49 | 0.00 | 0.30 | 0.80 | 0.68 | 0.14 | 0.40 | 1.14 |
| Middle | 0.31 | 0.00 | 0.17 | 0.56 | 0.44 | 0.01 | 0.23 | 0.85 |
| Richer | 0.33 | 0.00 | 0.18 | 0.58 | 0.50 | 0.03 | 0.27 | 0.95 |
| Richest | 0.49 | 0.02 | 0.27 | 0.89 | 0.76 | 0.42 | 0.39 | 1.48 |
| ANC | | | | | | | | |
| < 4 [RC] | | | | | | | | |
| >=4 | | | | | 0.76 | 0.23 | 0.48 | 1.19 |
| Place of delivery | | | | | | | | |
| Out of health facility [RC] | | | | | | | | |
| At health Facility | | | | | 0.59 | 0.04 | 0.36 | 0.98 |
| PNC | | | | | | | | |
| No | | | | | | | | |
| Yes | | | | | 1.20 | 0.55 | 0.66 | 2.17 |
| Current contraceptive use | | | | | | | | |
| Not using [RC] | | | | | | | | |
| Using | | | | | 0.19 | 0.00 | 0.10 | 0.35 |
| AIC | 997.85 | | | | 969.03 | | | |
| BIC | 1066.23 | | | | 1056.95 | | | |

*RC = Reference category*

Second, some of the responses might have been affected by recall bias, as the respondents might have difficulty remembering events that occurred in the last five years before the survey. Moreover, EDHS did not collect information related to some key socio-cultural variables which play important role in fertility preference. For this reason, the analysis did not account for some variables (such as norms and values, social influences or other family members' perspectives, especially the husband's, ) which may have a significant impact on reproductive decisions. The measurement of fertility preferences is based on what currently married women reported which can be changed over time.

## Conclusion and implications

This study investigated the factors influencing fertility preferences among high-parity women in four regions of Ethiopia. The finding reveals that maternal health service utilization (such as place of delivery and contraceptive use)

**Table 5** Population Attributable Fraction (PAFs) for selected risk factor of fertility preference in four region of Ethiopia ( *N* = 977)

| Risk factor | AOR | *P* value | (95%CI) | | PAF % |
|---|---|---|---|---|---|
| Women age ( < = 24 years age) | 0.98 | 0.39 | -1.25 | 3.22 | 1 |
| Women education (no education) | 0.25 | 0.31 | -0.24 | 0.74 | 20 |
| Religion (Muslim) | 1.23 | **0.00** | 0.86 | 1.60 | 59 |
| Type of place of residence (Rural) | -0.70 | **0.02** | -1.28 | -0.12 | 5 |
| Women currently working (not working) | 0.02 | 0.93 | -0.36 | 0.39 | 1 |
| Women autonomy on their own health care (decision made by her husband/ others) | 0.32 | 0.11 | -0.07 | 0.72 | 22 |
| Husband age ( < = 34 years age) | 0.31 | 0.32 | -0.30 | 0.91 | 3 |
| Husband education (no education) | -0.03 | 0.90 | -0.42 | 0.37 | -2 |
| Wealth index (poorest) | 0.68 | **0.00** | 0.29 | 1.08 | 38 |
| Family size ( < = 5) | 0.13 | 0.63 | -0.40 | 0.67 | 1 |
| Husband desire for more children (want more) | -0.06 | 0.72 | -0.40 | 0.28 | -2 |
| ANC (< 4) | 0.32 | 0.15 | -0.12 | 0.77 | 24 |
| Place of delivery (out of health facility) | 0.56 | **0.02** | 0.08 | 1.04 | 37 |
| PNC (no) | -0.21 | 0.49 | -0.81 | 0.39 | -21 |
| Current contraceptive use (not using) | 1.72 | **0.00** | 1.08 | 2.36 | 80 |
| **Total for only significant variables** | | | | | **219** |
| **Total for all variables** | | | | | **266** |

and socioeconomic conditions (such as religion, type of residence, and wealth index) significantly impacted fertility preferences. Interestingly, inadequate utilization of essential maternal health services (nonuse of institutional delivery and contraception) accounted for half of the conventional risk factors for fertility preferences.

To address these disparities, we recommend enhancing access to maternal health services through proactive measures, strengthening existing fertility control programs, and engaging religious leaders. Collaborating with religious institutions can promote safe deliveries, adoption of family planning, and overall well-being of women and their children. Additionally, localizing maternal services through implementing mobile clinics, community health workers, and outreach programs is essential. Empowering local leaders to champion maternal health will bridge gaps and ensure equitable access for women in remote areas.

#### Abbreviations

AIC Akaike information criterion
ANC Antenatal Care
AOR Adjusted Odd Ratio
BIC Bayesian information criterion
CI Confidence Interval
CSA Central Statistics Agency
EA Enumeration Area
EDHS Ethiopian Demographic and Health Survey
MHS Maternal Health service
PNC Post natal care
VIF Variance inflation Factor
WHO World Health Organization

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#### Author contributions

TS was involved in the study conceptualization, designing, analyzing, and interpreting the data, drafting, and final writing of this manuscript. NR provided the necessary guidance during the draft preparation, reviewing and revising the paper. Both authors read and approved the final manuscript.

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#### Data availability

Secondary data from ICF International's DHS programme (https://dhsprogram.com/data/new-user-registration.cfm). was used for this publication. The data is accessible.

## Declarations

#### Ethics approval and consent to participate

The 2016 EDHS (https://dhsprogram.com/methodology/Protecting-the-Privacy-of-DHS-Survey-Respondents.cfm) follows the required ethical approval procedure and their received participant consent during the data collection. We used publicly accessible secondary data from the 2016 EDHS for this manuscript, and we asked ICF International's DHS programme for permission to download and use the raw data as well. We were granted this permission through their platform at https://dhsprogram.com/data/new-user-registration.cfm.

#### Consent for publication

Not applicable.

#### Computing interests

The authors declare that they have no competing interests.

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## Publisher's note