FROM THE AMERICAN PEOPLE

COMPARING IDEAL AND COMPLETED FAMILY SIZE: A FOCUS ON WOMEN IN LOW- AND MIDDLE-INCOME COUNTRIES WITH UNREALIZED FERTILITY

DHS ANALYTICAL STUDIES 78

July 2021

This publication was produced for review by the United States Agency for International Development. It was prepared by Shireen Assaf and Lwendo Moonzwe Davis.

DHS Analytical Studies No. 78

Comparing Ideal and Completed Family Size: A Focus on Women in Low- and Middle-income Countries with Unrealized Fertility

Shireen Assaf[1,2]
Lwendo Moonzwe Davis[1]

ICF
Rockville, Maryland, USA

July 2021

[1] ICF
[2] The DHS Program

Corresponding author: Shireen Assaf, International Health and Development, ICF, 530 Gaither Road, Suite 500, Rockville, MD 20850, USA; phone: +1 301-407-6500; fax: +1 301-407-6501; email: Shireen.assaf@icf.com

Acknowledgments: The authors wish to thank Sara Yeatman for her comments on the report and Thomas Pullum for his guidance in the research process and his comments. We would also like to thank Tom Fish for producing the maps.

Editor: Diane Stoy
Document Production: Joan Wardell

This study was carried out with support provided by the United States Agency for International Development (USAID) through The DHS Program (#720-OAA-18C-00083). The views expressed are those of the authors and do not necessarily reflect the views of USAID or the United States Government.

The DHS Program assists countries worldwide in the collection and use of data to monitor and evaluate population, health, and nutrition programs. Additional information about The DHS Program can be obtained from ICF, 530 Gaither Road, Suite 500, Rockville, MD 20850 USA; telephone: +1 301-407-6500, fax: +1 301-407-6501, email: info@DHSprogram.com, Internet: www.DHSprogram.com.

Recommended citation:

Assaf, Shireen, and Lwendo Moonzwe Davis. 2020. *Comparing Ideal and Completed Family Size: A Focus on Women in Low- and Middle-income Countries with Unrealized Fertility*. DHS Analytical Studies No. 78. Rockville, Maryland, USA: ICF.

CONTENTS

TABLES

FIGURES

PREFACE

The Demographic and Health Surveys (DHS) Program is one of the principal sources of international data on fertility, family planning, maternal and child health, nutrition, mortality, environmental health, HIV/AIDS, malaria, and provision of health services.

One of the objectives of The DHS Program is to analyze DHS data and provide findings that will be useful to policymakers and program managers in low- and middle-income countries. DHS Analytical Studies serve this objective by providing in-depth research on a wide range of topics, typically including several countries and applying multivariate statistical tools and models. These reports are also intended to illustrate research methods and applications of DHS data that may build the capacity of other researchers.

The topics in this series are selected by The DHS Program in consultation with the U.S. Agency for International Development.

It is hoped that the DHS Analytical Studies will be useful to researchers, policymakers, and survey specialists, particularly those engaged in work in low- and middle-income countries.

Sunita Kishor
Director, The DHS Program

ABSTRACT

The study of fertility preferences in relation to the number of children is important for understanding the factors that contribute to fertility levels. There has been little research on women who have fewer than their ideal number of children, or unrealized fertility, in low- and middle-income countries. This report focuses on women age 40-49 in 25 countries from the four geographical regions of Western and Central Africa, Eastern Africa, Asia and the Middle East, and Latin America and the Caribbean. The report examines trends in fertility preferences, the distribution of unwanted fertility and unrealized fertility, and the factors associated with unrealized fertility. There were some significant increases in fertility preferences, especially in the African regions, although these were of very small magnitude. Unrealized fertility was the highest in Western and Central Africa, followed by Eastern Africa, and the remaining two regions. We find that having fewer than four children in the African regions and fewer than two children in the remaining two regions increases the likelihood of unrealized fertility. We also find little evidence of sex preferences after reaching a specific ideal number. We explored the relationship between unrealized fertility and other covariates such as education, wealth quintile, and contraceptive use. Some country-specific deviations from the regional results are also discussed.

Key words: Unrealized fertility, fertility preferences, ideal number of children, sex preferences

1 BACKGROUND OF THE REPORT

There has long been a focus on studying fertility outcomes and childbearing goals in an effort to understand the factors that contribute to fertility levels. Women who have fewer children than their ideal number have unrealized fertility, and those who have more than their ideal number have unwanted fertility. Ideally, every woman would achieve her desired fertility and avoid both unwanted fertility and unrealized fertility. Prior research in low- and middle-income countries (LMIC) focused on unwanted fertility. However, recent studies have emphasized the importance of examining both unwanted fertility and unrealized fertility (Bongaarts 2001; Bongaarts and Casterline 2013; Casterline and Han 2017; Nitsche and Hayford 2020; Yeatman, Trinitapoli, and Garver 2020). There is also increasing interest in studying unrealized fertility or the factors that are associated with women not meeting their fertility goals, although much of this research is focused in developed countries (Casterline and Han 2017). However, little attention has been given to women who have fewer children than intended, or unrealized fertility, in LMICs.

There is great interest in studying the fertility trends in Sub-Saharan Africa (SSA) and other LMICs due to the projected increase in population as a result of high fertility, which will result in social, economic, and environmental challenges (Bongaarts and Casterline 2013). Estimates of fertility projections provide valuable information for public health, fertility planning, and service provision. In addition, fertility and health outcomes, such as maternal morbidity and mortality, are linked. For example, older age at childbearing and higher fertility rates have negative effects on both maternal and child health outcomes and mortality (Billari et al. 2007; Girum and Wasie 2017; Rutstein and Winter 2015). Since reproductive rights include the right to freely decide the number, spacing, and timing of children, it is important to understand both unrealized fertility and unintended fertility and the role they might play in reproductive rights. This highlights the importance of continued research on fertility desires, behaviors, and trends, as well as the misalignment of childbearing goals and outcomes.

Several studies have examined trends in total fertility, both independently and by examining the main drivers for fertility change. Between 1990 and 2019, the global fertility rate fell from 3.2 to 2.5 live births per woman (United Nations Department of Economic and Social Affairs Population Division 2020). This decline varied by region, with fertility levels substantially higher in Africa. Between 2010 and 2019, 7 of the 10 countries with the largest reduction in total fertility rate were found in SSA, although the SSA decline is still occurring at a slower pace than other regions in the world (United Nations Department of Economic and Social Affairs Population Division 2020). Africa is still in the early stages of fertility transition, while Asia and Latin America are approaching replacement fertility or below (Searchinger et al. 2013). In SSA, the total fertility rate reached 4.6 births per woman in 2019, while in Latin America and the Caribbean it is 2.0 and in Eastern and South-East Asia, it is 1.8 births per woman (United Nations Department of Economic and Social Affairs Population Division 2020). Further studies show that the pace of fertility decline in Africa is much slower than Asia and Latin America (Bongaarts and Casterline 2013). Several factors can contribute to a decline in fertility, beginning with changes in the proximate determinants of fertility, such as marriage or contraceptive use, to indirect cultural and socioeconomic factors (Bongaarts 1978; Finlay, Mejía-Guevara, and Akachi 2018; Majumder and Ram 2015). Studying fertility preferences, especially in comparison to fertility behavior, can also shed light on the trends in fertility levels and the reasons for the slower rate of decline in fertility levels in SSA in comparison to other regions.

Studies indicate that women who say they want no more children are indeed less likely to have more children (Cleland, Machiyama, and Casterline 2020). A review of longitudinal studies conducted across Asia and Africa found that the baseline desire of women to stop childbearing was a strong predictor of subsequent fertility, although this study also found a discrepancy between preference and behavior, as well as instability in preference, especially in SSA (Cleland, Machiyama, and Casterline 2020). However, another study found that 40% of women in SSA did not meet their stated fertility intentions, and had fewer children than their ideal number, compared to 26% in non-SSA countries (Channon and Harper 2019). Compared to other LMICs, higher levels of education are not related to better correspondence between fertility intentions and outcomes in SSA (Channon and Harper 2019). In Middle and Western Africa countries, on average, 48% of women with secondary or higher education had fewer children than their ideal number of children, compared to 24% who had more children than their ideal (Channon and Harper 2019).

Factors associated with the realization of fertility intentions include education, employment status, religious affiliation, and overall life satisfaction (Bongaarts 2010; Spéder and Kapitány 2009). Social context also looks at unrealized fertility, with individual and social expectations about childbearing playing an important role in the perception of fertility problems (Barden-O'Fallon 2005). For example, in low-income agricultural societies, there is a tendency to desire larger numbers of children compared to higher-income societies with more developed secondary and tertiary sectors (Bongaarts and Casterline 2013). A study conducted across 30 SSA countries found that a woman’s level of education is negatively associated with increased fertility and desired family size (Bongaarts 2010). Cultural norms and ethnicity have also been found to be associated with unrealized fertility (Fayehun et al. 2020). A study conducted in Nigeria found that Hausa-Fulani women had greater odds of having unrealized fertility compared with women from other ethnic groups (Fayehun et al. 2020). Another study found that in SSA, a woman’s ability to meet fertility ideals was related to the region where she lived (Channon and Harper 2019).

There is also a possible link between sex preferences and unrealized fertility intentions. If one sex is preferred over the other or a specific sex composition is the ideal, women may report an ideal number of children that is greater than their current number if they have not reached that preference. For example, if a couple has only sons, it is possible they would increase their ideal number because they want at least one daughter. Studies on sex preferences and unrealized fertility have been inconsistent. Some studies have not found support for sex preference, while others have documented some associations between sex preference and fertility outcomes (Fuse 2010; Rossi and Rouanet 2015). An examination of 50 Demographic and Health Surveys (DHS) conducted between 2000 and 2008 found that although a balanced preference is the most common, countries and regions vary in the prevalence of son and daughter preference. Overall, daughter preferences were predominant in Latin America, the Caribbean, and several Southeast Asian countries, whereas son preference was prevalent in Southern and Western Asia and Northern Africa (Fuse 2010). Findings in SSA countries were mixed with son preference prevalent in 16 of the 28 countries examined (Fuse 2010). Another study conducted with African countries found strong and increasing son preference in North Africa, and a preference for a variety or no preference in most of SSA (Rossi and Rouanet 2015). A study conducted in India found that son preference was still persistent. More than 80% of the couples with only daughters wanted to have additional children, whereas in families with only sons, the chances of a subsequent pregnancy were inversely associated with the number of sons (Kastor and Chatterjee 2018).

Another study conducted across three South Asian countries found that contraceptive use was higher among women with more sons, and that having more sons was also associated with a decreased desire for another child (Jayaraman, Mishra, and Arnold 2009). In Nigeria, a study found that having only daughters was associated with higher odds of unrealized fertility (Fayehun et al. 2020). Further, a study conducted across 64 countries found that fertility behavior was consistent with son preference and that the fertility response to the absence of sons was larger in Central Asia and South Asia. Thus, the latent demand for sons is more likely to manifest when fertility levels are low. This study also found that girls tend to grow up with more siblings than boys, since those families with girl children would presumably continue to have children in hopes of having a boy. The larger family size has potential implications for overall well-being and resource allocation (Filmer, Friedman, and Schady 2009). Further, the sex of the firstborn child may also play a role in subsequent fertility preferences, with men and women both wanting more children after having a firstborn daughter and fewer children after having a firstborn son (Lamson 2020). Therefore, couples may adjust their ideal number of children based on the sex composition of their children, and this in turn will have an effect on unrealized fertility.

In this report, we focus on women age 40-49. We assume that women in this age group are near the end of their childbearing years and would therefore be suitable for comparing fertility preferences to the number of living children. The report attempts to answer the following research questions:

1. Have fertility preferences for the birth cohort of women age 40-49 in the most recent survey changed over time? This will help us understand if changes in fertility preferences are the drivers of fertility behavior.
2. What is the distribution of unrealized and unwanted fertility by region and countries?
3. What are the main determinants of unrealized fertility among women age 40-49? This will help us understand if specific subgroups of women have higher unrealized fertility compared to others.
4. Do sex preferences exist after achieving a specific ideal number of children?

2 DATA AND METHODS

2.1 Data

Data from countries with four DHS between 1998 and 2019 (between a 15- and 20-year span) were selected for the analysis (see Table 1). This resulted in the selection of 25 countries from the four geographical regions of Western and Central Africa (7 countries), Eastern Africa (8 countries), Asia and the Middle East (8 countries), and Latin America and the Caribbean (2 countries). Since the data were only available for a select number of countries from each region, especially for Latin America and the Caribbean, caution should be taken in generalizing the findings to each region. All surveys were used in the trend analysis section of this report, while only the most recent survey was used for the remaining analyses that included the descriptive results of the outcome and the regressions.

Table 1 Surveys included in the analysis

Region	Country	DHS surveys			
Western and Central Africa	Benin	2017-18	2011-12	2006	2001
	Cameroon	2018-19	2011	2004	1998
	Ghana	2014	2008	2003	1998-99
	Guinea	2018	2012	2005	1999
	Mali	2018	2012-13	2006	2001
	Nigeria	2018	2013	2008	2003
	Senegal	2018	2014	2010-11	2005
Eastern Africa	Ethiopia	2016	2011	2005	2000
	Kenya	2014	2008-09	2003	1998
	Malawi	2015-16	2010	2004-05	2000
	Rwanda	2014-15	2010-11	2005	2000
	Tanzania	2015-16	2009-10	2004-05	1999
	Uganda	2016	2011	2006	2000-01
	Zambia	2018-19	2013-14	2007	2001-02
	Zimbabwe	2015	2010-11	2005-06	1999
Asia and the Middle East	Armenia	2015-16	2010	2005	2000
	Bangladesh	2017-18	2014	2007	2004
	Cambodia	2014	2010-11	2005-06	2000
	Egypt	2014	2008	2005	2000
	Indonesia	2017	2012	2007	2002-03
	Jordan	2017-18	2012	2007	2002
	Nepal	2016	2011	2006	2001
	Philippines	2017	2013	2008	2003
Latin America and the Caribbean	Colombia	2015-16	2009-10	2004-05	2000
	Haiti	2016-17	2012	2005-06	2000

2.2 Outcome variables

For the trend analysis, we focus on the ideal number of children and whether this changed significantly over time. The question for ideal number of children is as follows for women who have living children: "If you could go back to the time you did not have any children and could choose exactly the number of children to have in your whole life, how many would that be?" Women without living children are asked "If you could choose exactly the number of children to have in your whole life, how many would that be?"

After this question, women are asked how many of the children they would like to be boys, girls, or either. Thus, we have variables for ideal number of children, ideal number of boys, and ideal number of girls. Women usually give a numerical response to these questions, although in some cases, a non-numerical response such as “It is up to God” is given. As shown in Appendix Table 1, the percentage of women age 40-49 who gave a non-numerical response for ideal number of children was less than 5% for most countries included in our analysis in the most recent survey. However, this percentage was higher in several countries in Western and Central Africa and reached over 15% in Guinea, Mali, and Senegal. It was disproportionally high in Ethiopia with 18% of women giving a non-numeric response. Women who provided a non-numerical response were excluded from the analysis. An alternative would be to impute the missing values to obtain an estimated numerical value for women who give a non-numerical response. However, this would introduce error into the analysis, and we could not confidently select a model that would predict the ideal number of children. The exclusion of non-numerical responses is a limitation of our analysis that would disproportionally affect the results for the Western and Central Africa region. We also excluded the non-numerical responses for ideal number of boys and ideal number of girls.

The second set of outcome variables is derived from the comparison of the women’s reported ideals and current number of living children. We construct a variable from the difference of these two variables and categorize the responses as: 1. ideal is less than current number of children (unwanted fertility), 2. ideal equals current number, and 3. ideal is more than current number of children (unrealized fertility). Similar variables were constructed by taking the difference between the ideal number of boys and current number of living sons, and the difference between the ideal number of girls and current number of living daughters.

2.3 Methods

2.3.1 Trend analysis

For all analyses, we focus on women age 40-49 in the most recent survey. In Appendix Table 2, we see that among women age 15-49, fewer than 5% have a birth between age 40-49 for all the countries in the analysis. For the trend analysis, we are working with cross-sectional data, and are only able to follow birth cohorts over time. We construct birth cohorts of women in the most recent survey and track the birth cohort for women age 40-49 in the most recent survey in the trend analysis. To determine the significance of the change from one survey to the next, we fit a Poisson regression for each of the variables of ideal number of children, ideal number of boys, ideal number of girls, current number of living children, current number of living sons, and current number of living daughters with the year of the survey as the main independent variable (or range of years for the regional analysis). We perform this analysis for each country separately and for each of the four geographical regions after appending the surveys. When using appended data for the analyses, we give equal weight to each survey so that one survey does not dominate the results of the other due to the relatively large sample size. Line plots are produced to summarize the trends for each geographical region with a solid line indicating a significant change between successive surveys and a dotted line indicating no significant difference. A table then summarizes the trend results for the ideal number of children, ideal number of boys, and ideal number of girls for all the countries.

2.3.2 Descriptive analysis and maps

The percentage distribution of unrealized fertility for the total, boys, and girls is examined by region, and also for each country separately in the most recent survey. Two national maps are also produced to summarize the percentages of unrealized fertility and unwanted fertility for each country for easy comparability.

2.3.3 Regression analysis

The regression analysis focuses on unrealized fertility, when women report that their ideal number of children is more than their current number of children. Unrealized fertility for boys or girls was not included in the regression analysis. This analysis was performed among women age 40-49 in the most recent survey. The sample size of women age 40-49 for each country is shown in Appendix Table 2. Adjusted logistic models are fit for each geographical region with the following controls: education level, age at first birth, wealth quintile, place of residence, exposure to family planning (FP) messages from radio, television, or newspapers, and contraceptive use. For the models that were fit for each region using appended data, the country was also included as a variable in the model. Three separate models with the same outcome of unrealized fertility are fit to include fertility-related variables that are highly correlated and therefore could not be included in the same model. Model 1 includes the total number of living children, Model 2 includes the total number of boys and total number of girls, and Model 3 includes a sex composition variable.

Due to the different distributions of the number of children by regions, the fertility-related variables for number of living children, number of living boys, number of living girls, and sex composition were categorized differently by regions as shown in Table 2 below. The distribution of these variables for each region is also shown in Appendix Table 6.

Table 2 Coding of fertility variables by region

	Western and Central Africa and Eastern Africa	Asia and the Middle East, and Latin America and the Caribbean
Number of children	0-2, 3, 4, 5, and 6 or more children	0-1, 2, 3, and 4 or more children
Number of living boys or girls	0-1, 2, 3, and 4 or more	0, 1, 2, and 3 or more
Sex composition	• 0-3 children, • 4 children with more sons than daughters, • 4 children with more daughters than sons, • 2 sons and 2 daughters, • 5 children with more sons than daughters, • 5 children with more daughters than sons, and • 6 or more children	• 0-1 children, • 1 son and 1 daughter, • 2 sons and no daughters, • no sons and 2 daughters, • 3 children with sons more than daughters, • 3 children with daughters more than sons, and • 4 or more children

All analyses considered the sampling design and sampling weights, and were performed with Stata 16 software.

3 RESULTS

The results contain four subsections. We describe the distribution of fertility preferences, trends in fertility preferences, the distribution of ideal minus current number of children, and finally, the regression results for unrealized fertility. The results are presented by geographical regions with country-specific results found in the Appendix tables.

3.1 Distribution of fertility preferences

Figure 1 Percent distribution of ideal number of children for women age 40-49 in the most recent survey for each country in the analysis

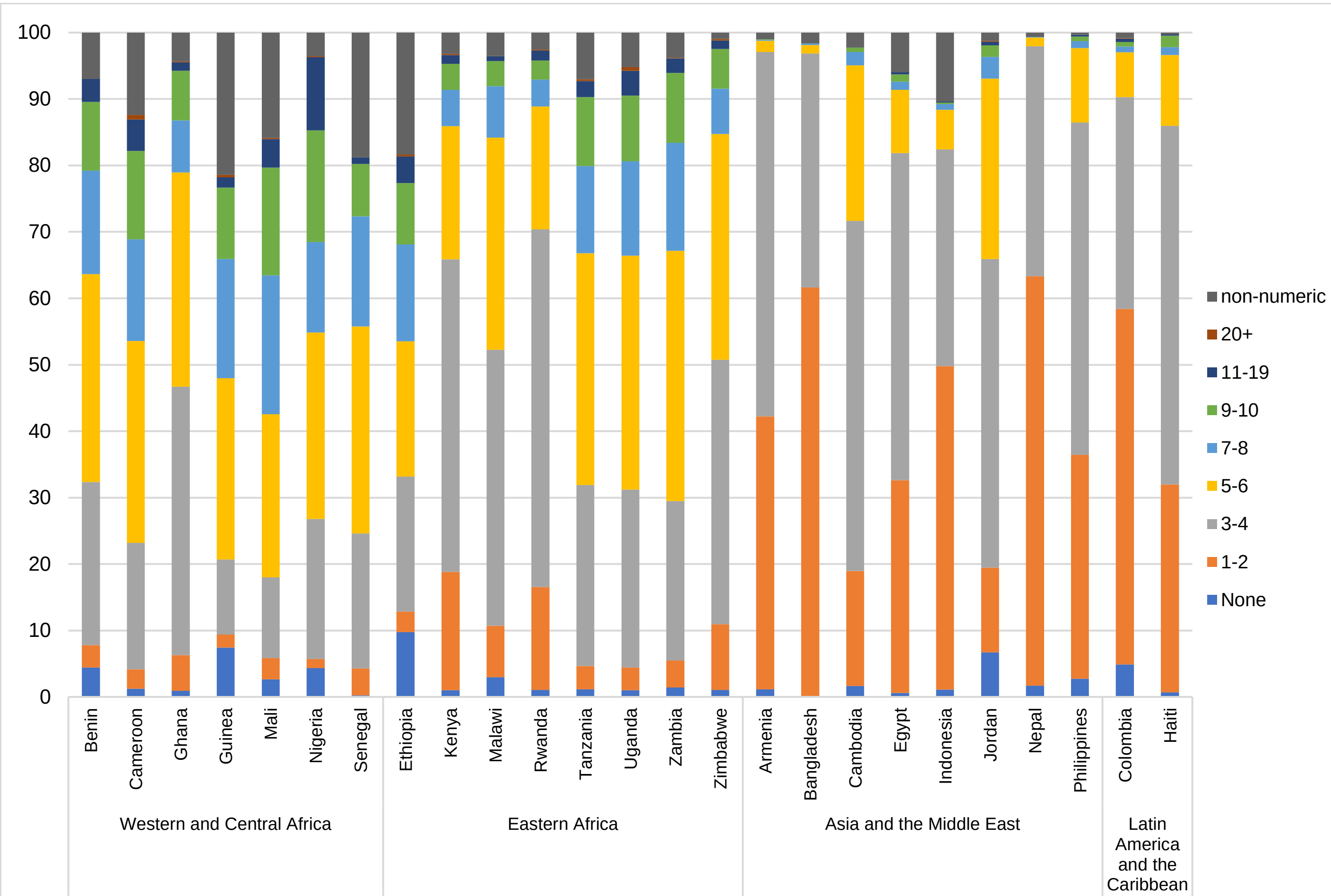


Figure 1 describes the percent distribution of ideal number of children for women age 40-49 in the most recent survey for each country. These percentages are also summarized in Appendix Table 1 along with the mean ideal number of children. The figure shows preferences for larger family sizes in the African regions compared to the other two regions. Countries in the African regions had higher percentages of women who ideally wanted 5 or more children compared to the countries in the other two regions. There were some variations between the countries within each region. For example, Ghana had a very high percentage of women with an ideal of 3-4 children (40%) compared to the rest of the countries in the Western and Central

Africa region, and it also had the lowest mean ideal number of children as shown in the Appendix table. A similar pattern was found for Kenya and Rwanda in the Eastern Africa region. In Asia and the Middle East, women from most countries ideally wanted either 1-2 or 3-4 children. However, Cambodia and Jordan had high percentages of women who wanted 5-6 children compared to the remaining countries in that region. Approximately 60% of women in Bangladesh and Nepal ideally wanted 1-2 children. Finally, women in Cambodia preferred smaller family size compared to women in Haiti.

Non-numeric responses were the highest in Western and Central Africa with 21% in Guinea and 19% in Senegal. Ethiopia had a much higher percentage of non-numeric responses compared to the remaining countries in Eastern Africa, with 18% compared to 7% and less in the remaining countries. Several countries including Colombia, Haiti, Nepal, the Philippines, and Zimbabwe had a non-numeric response rate less than 1%. Non-numeric responses were excluded from the remaining analysis in the report.

3.2 Trends in fertility preferences

Figures 2-5 summarize the trends in each region in the mean ideal number of children and number of living children for the total, boys, and girls. The trend analysis focuses on the birth cohort of women who were age 40-49 in the most recent survey. The results show whether the fertility preferences for this birth cohort changed over time. A dashed line indicates no statistically significant change, while a solid line indicates a significant change. It is expected that the number of children in a cohort increases over time as women grow older and have more children.

Figure 2 Trends in fertility preferences and number of living children in Western and Central Africa

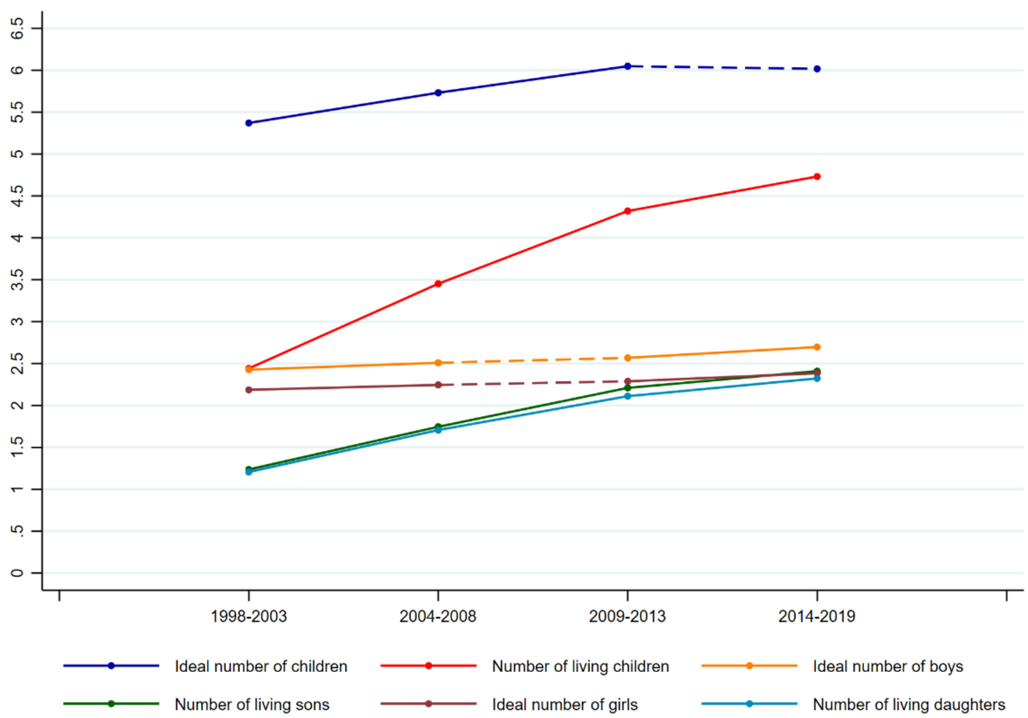


Figure 3 Trends in fertility preferences and number of living children in Eastern Africa

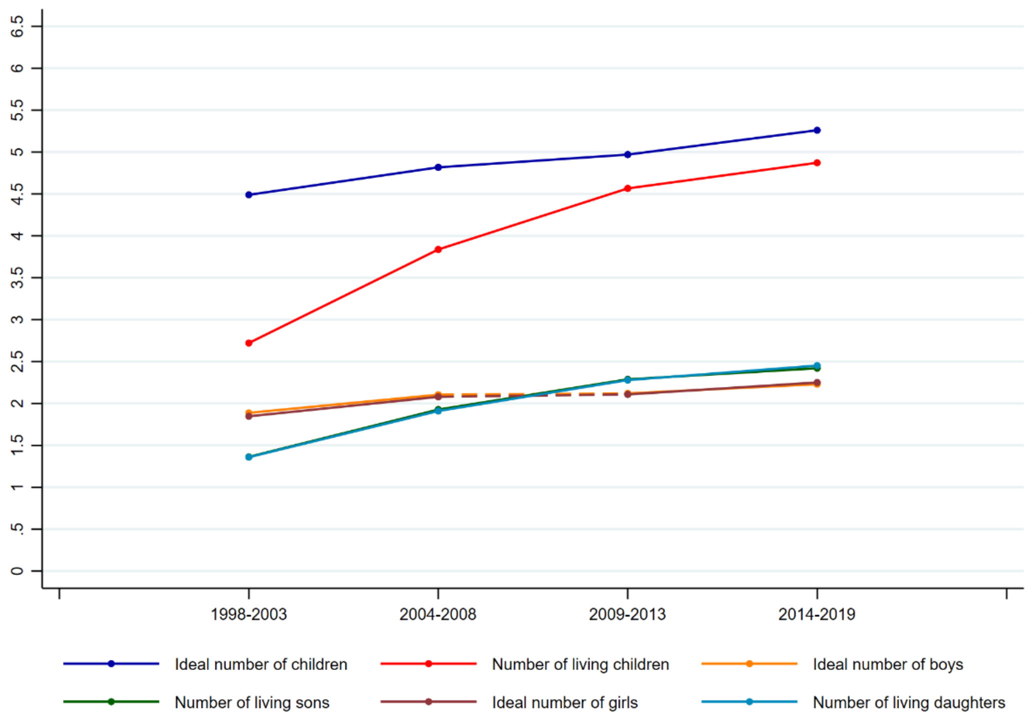


Figure 4 Trends in fertility preferences and number of living children in Asia and the Middle East

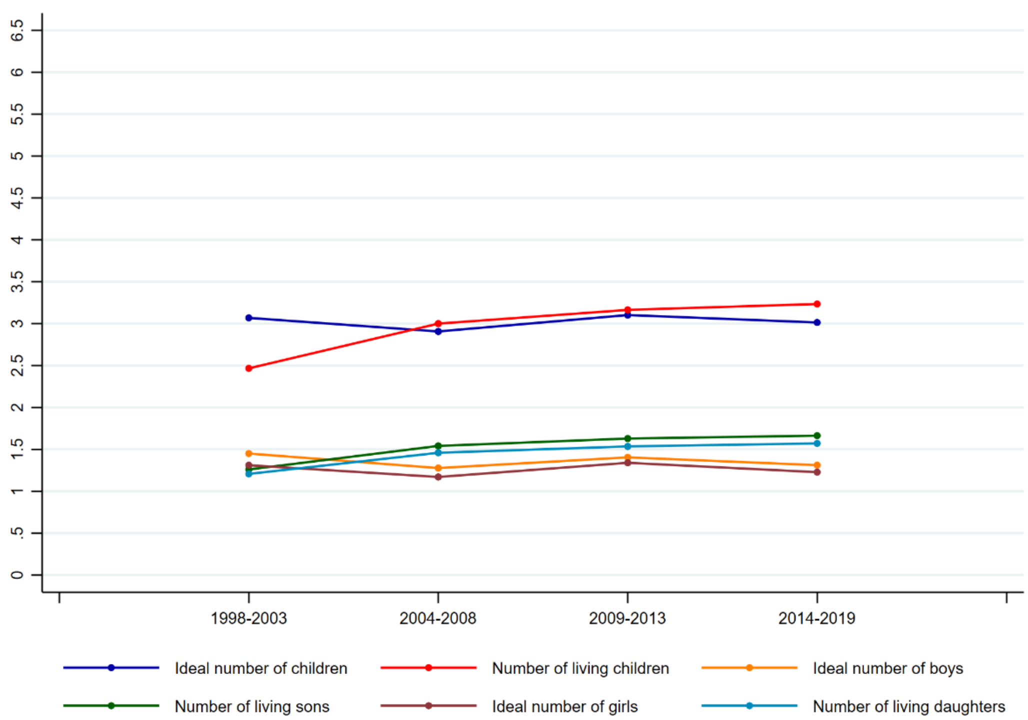
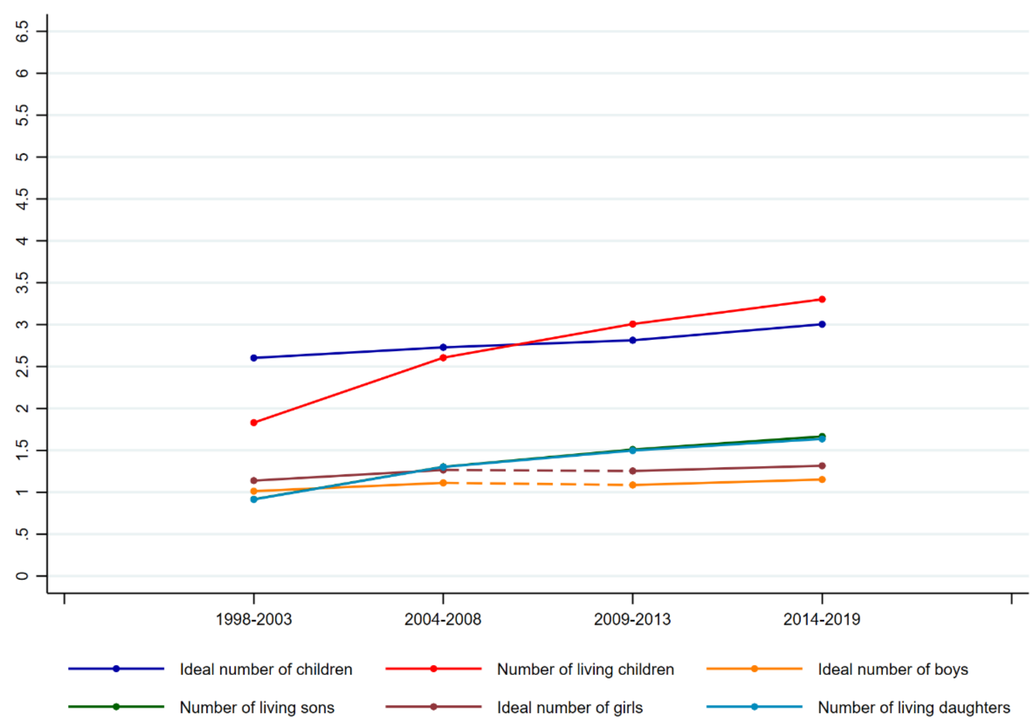


Figure 5 **Trends in fertility preferences and number of living children in Latin America and the Caribbean**



Overall, we observe that Western and Central Africa had the highest mean ideal number of children, followed by Eastern Africa, and the remaining two regions, which had approximately equal mean ideal numbers of children. The same pattern is observed for the ideal number of boys and ideal number of girls. In Appendix Table 3, which includes country-specific estimates, we see that the mean ideal number of children in the most recent survey for the total was 6.0 in Western and Central Africa (from 5.1 in Ghana to 6.7 in Mali and Nigeria), 5.3 in Eastern Africa (from 4.1 in Rwanda to 6.1 in Uganda), 3.0 in Asia and the Middle East (from 2.4 in Nepal to 4.0 in Jordan), and 3.0 in Latin America and the Caribbean (from 2.6 in Colombia to 3.4 in Haiti).

In general, across all regions, we see significant increases in the ideal number of children. However, as shown in Figures 2-5, the increases were small in magnitude. In Appendix Table 3, for the two African regions, we see an increase of approximately 0.3 in the total mean ideal number of children between successive time periods. For the remaining two regions, the increases were between 0.1 and 0.2 children. The overall change between the first time period and the last was a 0.7-0.8 increase for the African regions, 0.4 increase for Latin America and the Caribbean, and a decrease of approximately 0.1 child for Asia and the Middle East. These changes were statistically significant, although they are very small. Changes over time were even smaller for the ideal number of boys and ideal number of girls. We also see very similar estimates for the ideal number of boys and girls. In Western and Central Africa, there was slightly higher mean ideal number of boys compared to girls, but this difference was less than 0.3 for each time period.

In Appendix Table 3, we also observe the country-specific trends in the mean ideal number of children. Differences indicated in bold are greater than 0.5 in magnitude. We see few changes over 0.5 children between successive surveys for most countries. The largest differences between the first and last survey in the analysis were found in the African countries and were mainly for the total ideal number of children. Only three countries, Uganda, Zambia and Zimbabwe, had a difference of greater than one child between the first and last survey. Uganda and Zambia also had a difference of greater than 0.5 child for the ideal number of boys and girls between the first and last survey. None of the remaining countries had a change of more than 0.5 children for the ideal number of boys or girls. The exception was Rwanda with a 0.51 decrease in ideal number of girls between the first and last survey.

In addition to trends in fertility preferences, the comparison of the mean ideal number of children to the number of living children in Figures 2-5 provides an initial description of the level of unrealized fertility (where ideal is greater than current number) and unwanted fertility (where ideal is lower than the current number) and how these change over time for the selected birth cohort. In Western and Central Africa, we see in Figure 2 a higher mean ideal number of children compared to number of living children in each time period, which indicates that there is unrealized fertility. This gap is also the largest compared to the other regions. This finding is demonstrated in Section 3.3. There was a slight narrowing of this gap after women had 4.5 children. The ideal number of boys remained relatively steady at 2.5 boys across the time periods and the ideal number of girls at approximately 2 girls. Unrealized fertility was greater for boys compared to girls in this region.

In Eastern Africa in Figure 3, the gap between total ideal number of children and number of living children began to decrease in the period prior to the most recent survey, after women in this birth cohort had 4.5 living children. The gap between ideal number of boys/girls and number of living sons/daughters was relatively small and decreased after having a mean of 2 boys/girls. In fact, in the last two time periods, there were slightly more boys/girls than the ideal number, which indicated a shift towards unwanted fertility.

In Asia and the Middle East in Figure 4, there was very little difference between the mean ideal number of children and the number of living children, especially after having a mean of 3 children. We see a slightly larger mean number of living sons/daughters compared to the ideal number of boys/girls after having a mean of 1.5 boys/girls. This indicates unwanted fertility when fertility preferences were asked for each sex separately.

In Latin America and the Caribbean in Figure 5, there was no unrealized fertility after women had a mean of 2.5 children, and in the last two time periods, we see evidence of some unwanted fertility. We see the same pattern for the ideal number of boys/girls with no unrealized fertility after having a mean of one boy/girl, and with some evidence of unwanted fertility in the two most recent time periods.

3.3 Distribution of unwanted fertility and unrealized fertility

By taking the difference between the ideal number of children and the current number of living children, we can observe where women age 40-49 have experienced unwanted fertility (ideal<current number), have reached their ideal (ideal=current number), or have unrealized fertility (ideal>current number). Figures 6-9 summarize these distributions in each region for total children, boys, and girls. These estimates are based on the most recent survey for each country and women age 40-49. Appendix Table 4 provides these estimates with 95% confidence intervals (C.I.) as well as the country-specific estimates.

Figure 6 **Distribution of ideal minus current number of children in Western and Central Africa**

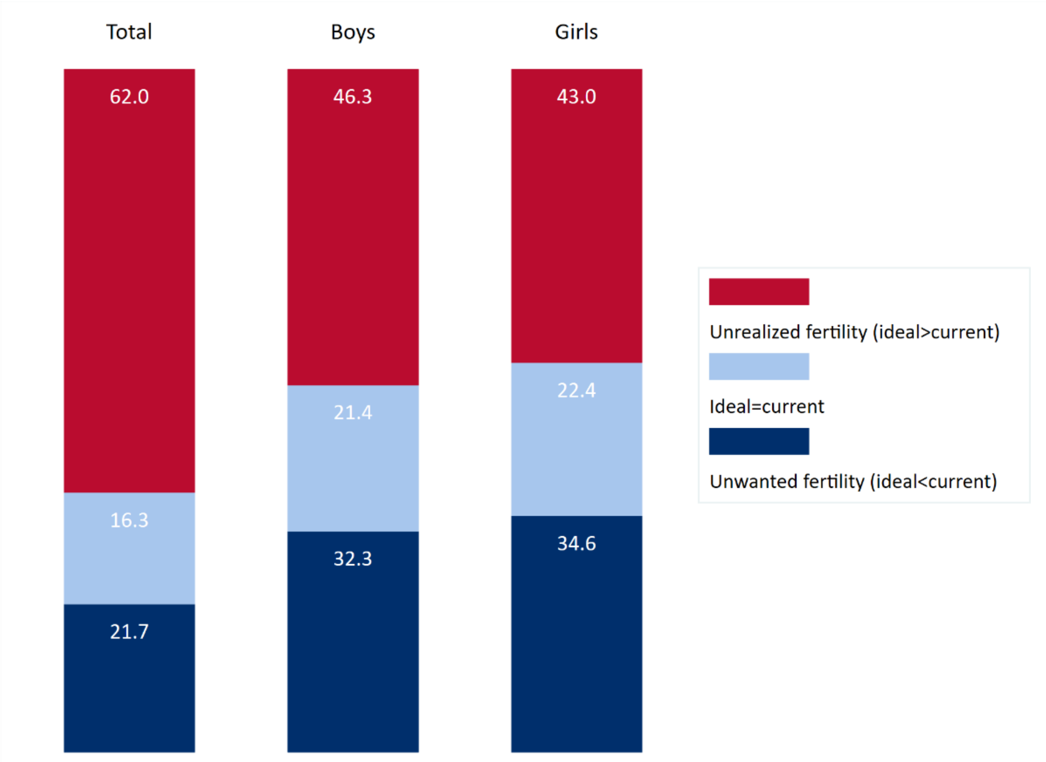


Figure 7 **Distribution of ideal minus current number of children in Eastern Africa**

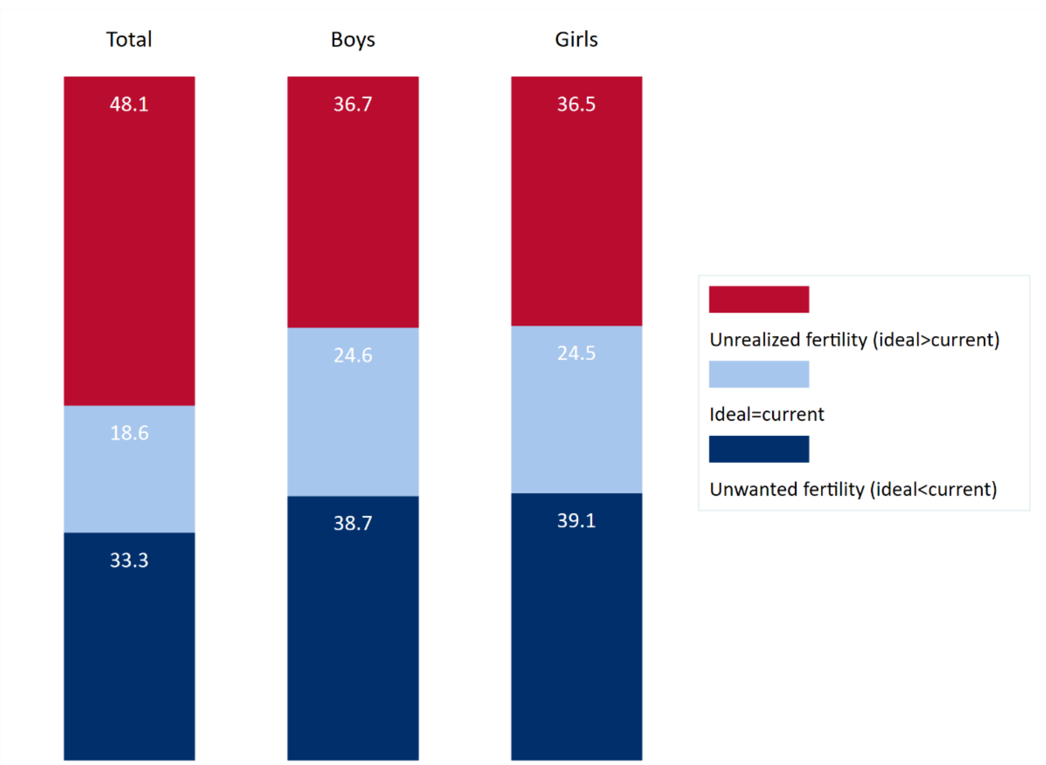


Figure 8 **Distribution of ideal minus current number of children in Asia and the Middle East**

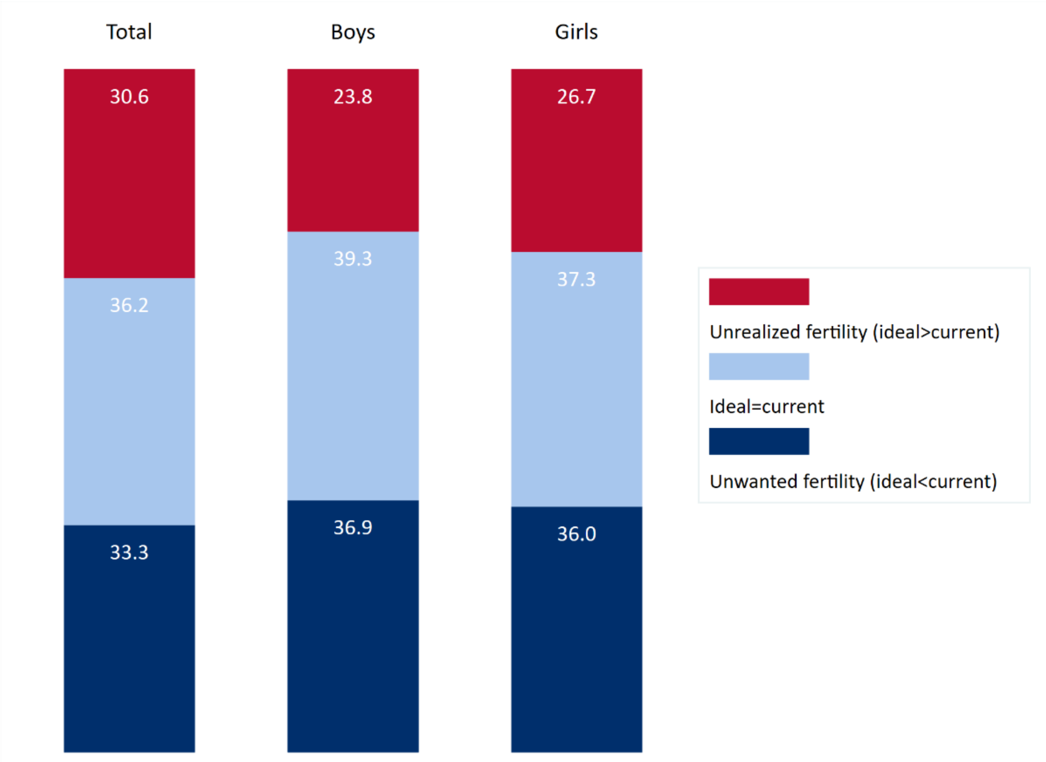
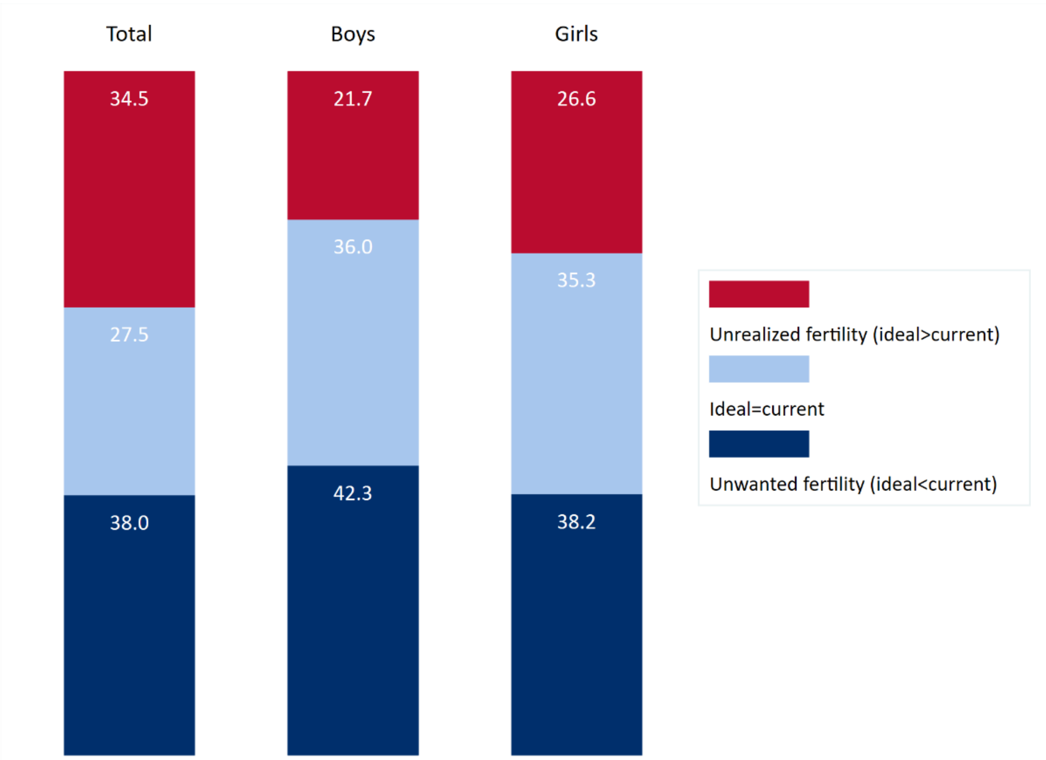


Figure 9 **Distribution of ideal minus current number of children in Latin America and the Caribbean**



Overall, when we compare all regions, we see that Western and Central Africa had the highest percentage of unrealized fertility (62%: 95% C.I. 61.9%, 63%), followed by Eastern Africa (48%: 95% C.I. 47%, 49%), Latin America and the Caribbean (35%: 95% C.I. 33%, 36%), and Asia and the Middle East (31%: 95% C.I. 30%, 31%). Unwanted fertility was the highest in Latin America and the Caribbean (38%: 95% C.I. 37%, 40%), and was approximately 33% for both Eastern Africa and Asia and the Middle East, and 22% in Western and Central Africa. Finally, over one-third of women in Asia and the Middle East reached their ideal number of children (36%: 95% C.I. 35, 37%), which was the highest compared to the remaining regions. This was followed by Latin America and the Caribbean (28%: 95% C.I. 26%, 29%), Eastern Africa (19%: 95% C.I. 47%, 49%), and Western and Central Africa (16%: 95% C.I. 16%, 17%). These regional estimates should be considered with caution because there are sometimes large variations across countries, as discussed below.

In Western and Central Africa (Figure 6), more than half of women age 40-49 had unrealized fertility (62%). Unrealized fertility did not differ greatly for wanting more boys (46%) or wanting more girls (43%). This indicates that the number of children appears to be more important for wanting more children than the sex composition. Only 16% of women age 40-49 have their ideal number of children and approximately one-fifth had their ideal number of boys or girls. Approximately one-fifth of women in this region had unwanted fertility (22%) compared to approximately one-third with unwanted fertility for boys (32%) or girls (35%). For the country-specific estimates in this region, shown in Appendix Table 4, unwanted fertility ranged from 16% in Cameroon to 22% in Senegal, with women having their ideal number of children ranging from 12% in Mali to 20% in Ghana, and unrealized fertility ranging from 55% in Benin to 69% in Guinea.

As shown in Figure 7, fewer than half of women age 40-49 in Eastern Africa had unrealized fertility (48%). This was lower when analyzed by sex and did not differ between boys and girls (both 37%). As in Western and Central Africa, this indicates that sex composition may not be important for wanting more children. Almost one-fifth of women age 40-49 had their ideal number of children (19%) and approximately a quarter of these women had their ideal number of boys or girls (both 25%). As shown in Appendix Table 4, unwanted fertility ranged from 15% in Zimbabwe to 48% in Rwanda, the ideal number of children from 14% in Ethiopia to 25% in Kenya, and unrealized fertility from 34% in Kenya to 64% in Zimbabwe. This region exhibited much larger variations across countries compared to West and Central Africa and especially in unwanted fertility and unrealized fertility.

In Asia and the Middle East shown in Figure 8, there was an almost equal distribution across the three categories of unintended pregnancy (33%), ideal equal current number (36%), and unrealized fertility (31%). This was not the case for the distribution by boys and girls. We see almost equal percentage of unwanted fertility for boys and girls (36-37%), but slightly higher unrealized fertility for girls (27%) when compared to boys (24%). There were very large variations across countries, especially due to Armenia and Nepal with very different distributions. Unwanted fertility ranged from 6% in Armenia to 57% in Nepal, reaching the ideal number of children ranged from 31% in Nepal to 46% in Armenia, and unrealized fertility from 12% in Nepal to 48% in Armenia. The distribution for Bangladesh was similar to that of Nepal while the remaining countries had a distribution that was nearly one-third in each category. The largest variation across countries was found for unwanted fertility in this region, with a 51 percentage-point difference between Armenia and Nepal. Armenia had the lowest percentage of unwanted fertility across all countries in the analysis.

Only two countries are included from Latin America and the Caribbean: Colombia and Haiti. In Figure 9, we see that 35% of women had unrealized fertility, which did not differ by the two countries. The total unrealized fertility was higher than unrealized fertility for boys or girls. As we have observed in the Asia and Middle East region, unrealized fertility for girls (27%) was higher than for boys (22%). Over a quarter of women (28%) in this region had their ideal number of children, which ranged from 18% in Haiti to 37% in Colombia. Overall, 38% of women age 40-49 in this region had unwanted fertility, ranging from 28% in Colombia to 48% in Haiti.

Figure 10 Unrealized fertility levels for the countries in the analysis among women age 40-49

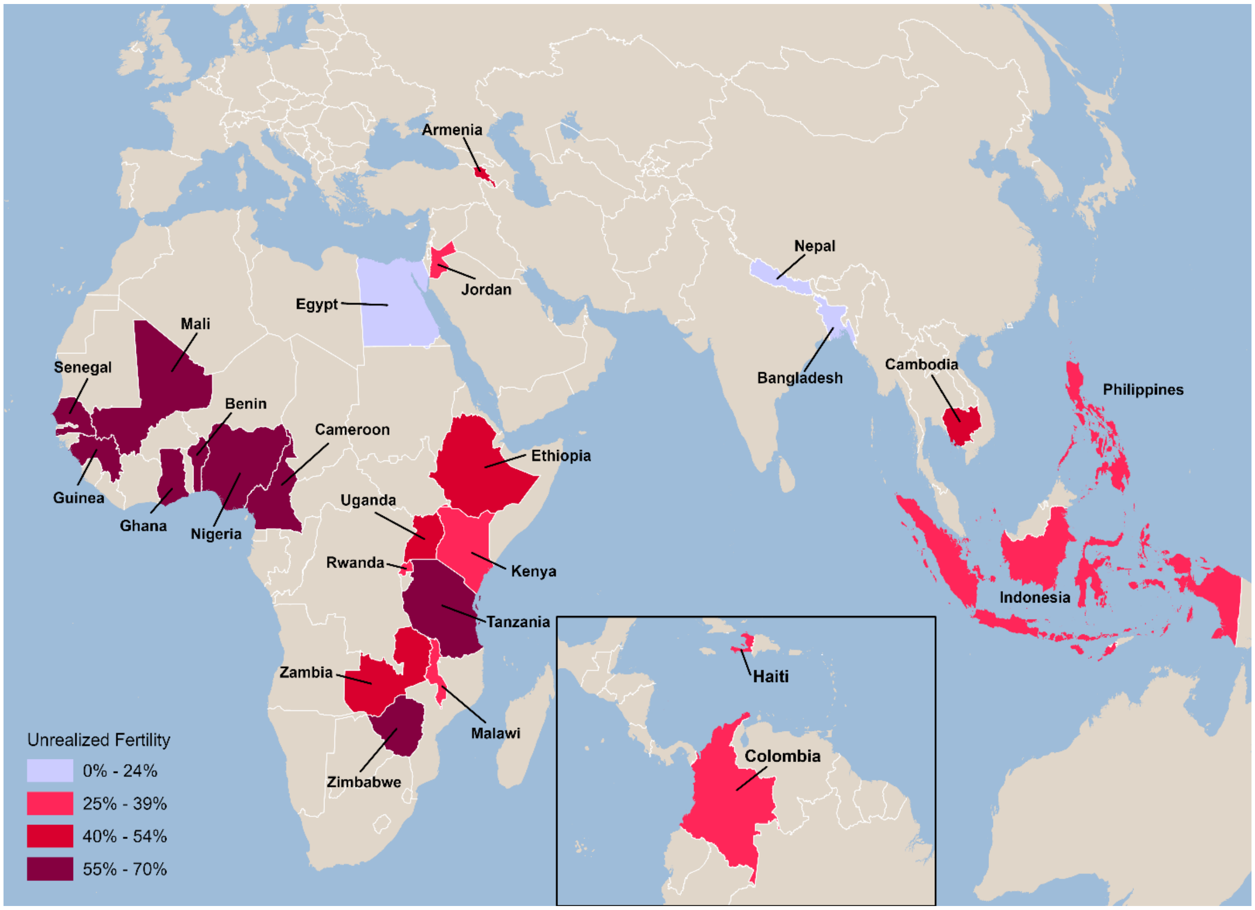
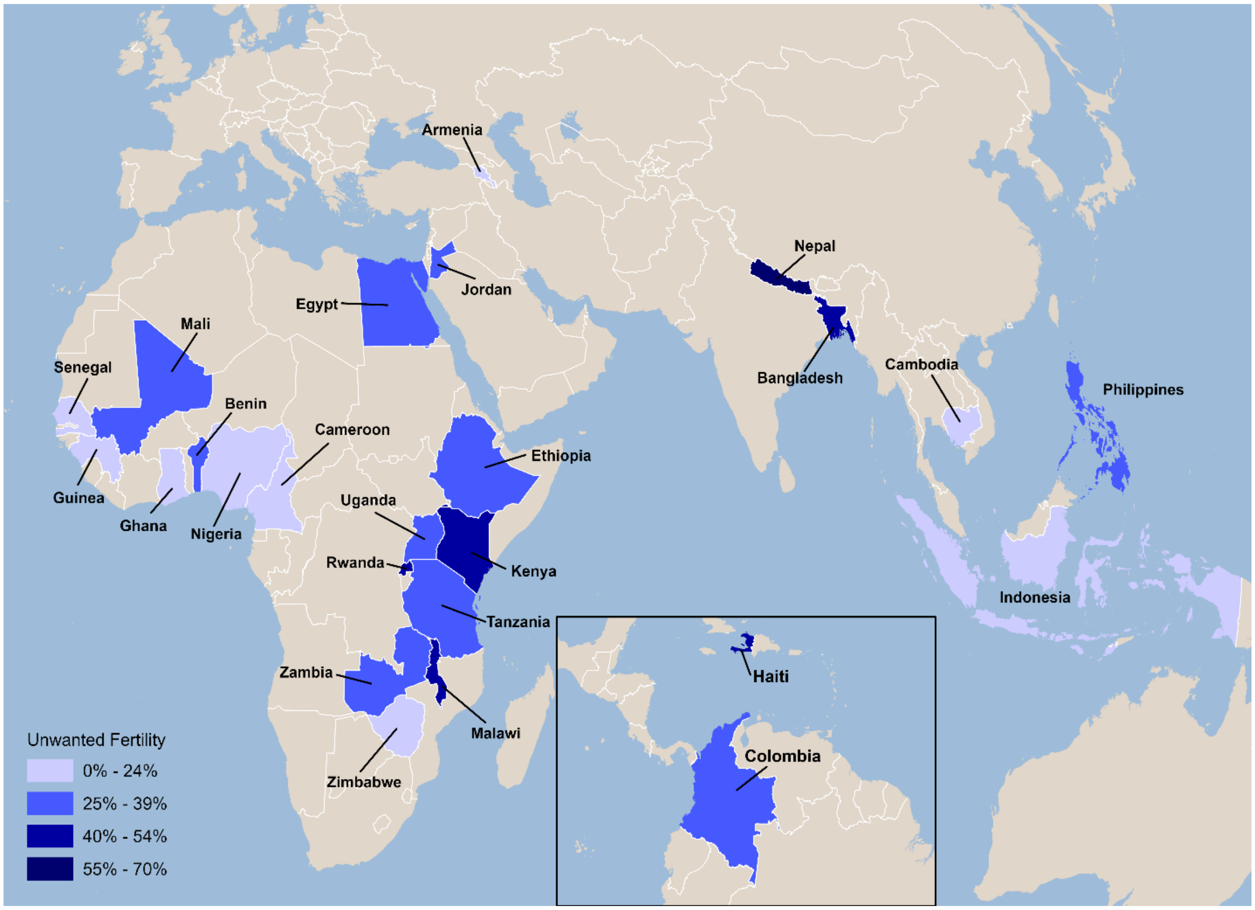


Figure 11 Unwanted fertility levels for the countries in the analysis among women age 40-49



The maps in Figures 10 and 11 provide a summary of levels of unrealized and unwanted fertility for the countries in the analysis among women age 40-49 in the most recent surveys. These values are also found in Appendix Table 4. In Western and Central Africa, we see uniformly high levels of unrealized fertility, with all countries above 54%. There is more variability in Eastern Africa as shown in Kenya compared to Tanzania. Egypt and Nepal had the lowest unrealized fertility of all the countries in the analysis. In Figure 11, we see the highest unwanted fertility levels in Nepal, which was above 54%, followed by Bangladesh, Haiti, Rwanda, Kenya, and Malawi with unwanted fertility levels between 40-54%. The lowest unwanted fertility levels were in Armenia, Zimbabwe, Cameroon, Nigeria, Guinea, Ghana, Indonesia, and Cambodia, which were all below 25%.

Appendix Table 5 summarizes the unrealized fertility levels by the country regions. The highest regional disparities were found in Kenya, Ethiopia, and Tanzania. For example, in Kenya, 90% of women age 40-49 in the North Eastern region had unrealized fertility compared to 23% in Nyanza. In Ethiopia, this ranged from 89% in Somali to 42% in Afar and 44% in Oromia. The smallest regional disparities were found in Indonesia, Rwanda, Bangladesh, Egypt, and Malawi with less than a 10 percentage-point difference between the region with the highest unrealized fertility and the region with the lowest.

3.4 Regression results

Adjusted logistic regressions were fit for unrealized fertility for women age 40-49 in each region. The distribution of the variables used in the regressions is found in Appendix Table 6. As noted in the methods, given the different distributions for the number of children in the African regions compared to the other regions, the fertility-related variables were coded differently. We see that for the African regions, approximately 40% of women age 40-49 had six or more children compared to 40% of women in the remaining two regions who have four or more children. Women's education and contraceptive use was lower in the African regions compared to the other two regions, with a higher proportion of women in the African region having their first birth before age 20 (almost half of women in the African regions compared to almost a third in the remaining regions). Eastern Africa had the highest percentage of women who lived in rural areas (74%), followed by those in Western and Central Africa (59%), Asia and the Middle East (50%), and Latin America and the Caribbean (38%). Approximately half of women were exposed to FP messages in all regions.

The regression coefficients are summarized in Figures 12-19 and Appendix Tables 6-9. The Appendix tables show the estimates for the regression models fit for each region and for the countries within that region. The estimates highlighted in blue show the results in the country-specific regressions that differ in significance from the regional results. As discussed in the methods section, we fit three models for each region or country for the same outcome of unrealized fertility for the total number of children: Model 1 includes the total number of children as an independent variable, Model 2 includes number of sons and daughters, and Model 3 a sex composition variable (Figures 12, 14, 16, and 18). The summary of the regression coefficient for the controls is found in Figures 13, 15, 17, and 19 for each region. Only the estimates from Model 1 were shown for the controls since they were nearly identical to the results for Models 2 and 3. The figures for the controls do not show the results for the age at first birth, place of residence, and exposure to FP messages since these were mostly non-significant and/or had very small coefficients (see Appendix tables).

Figure 12 Adjusted logistic regression coefficients of unrealized fertility for the fertility variables in women age 40-49 in Western and Central Africa

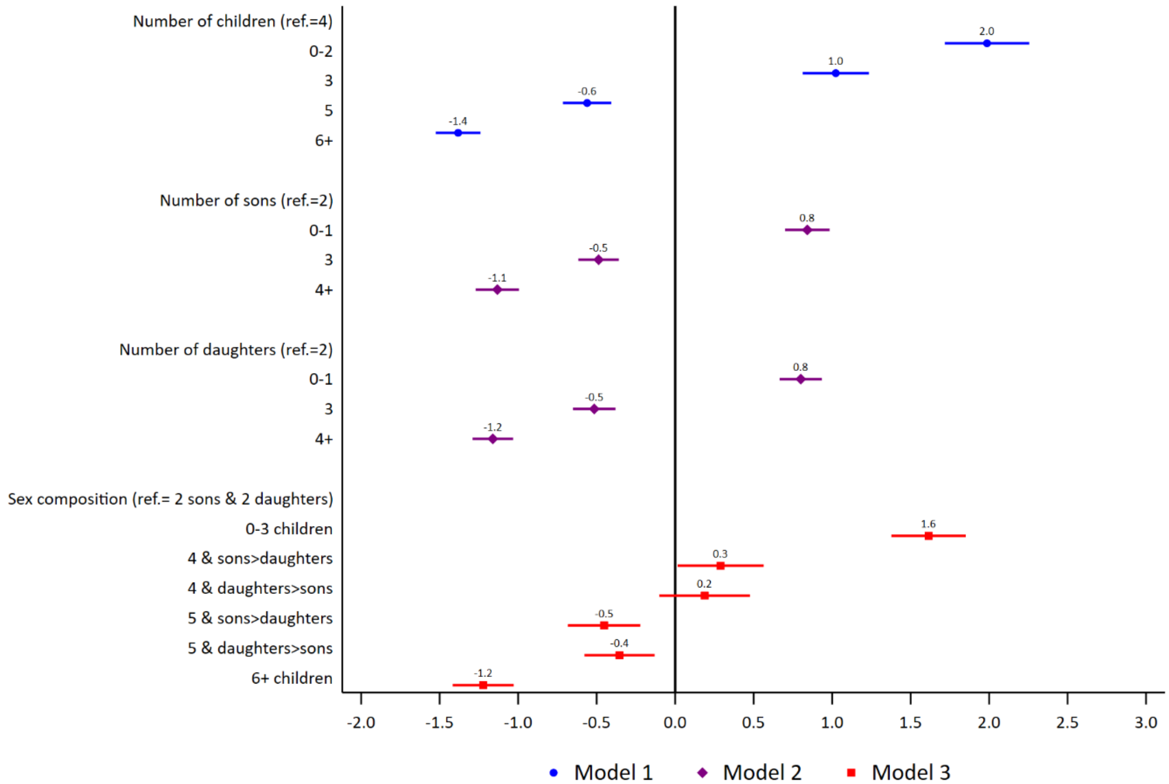
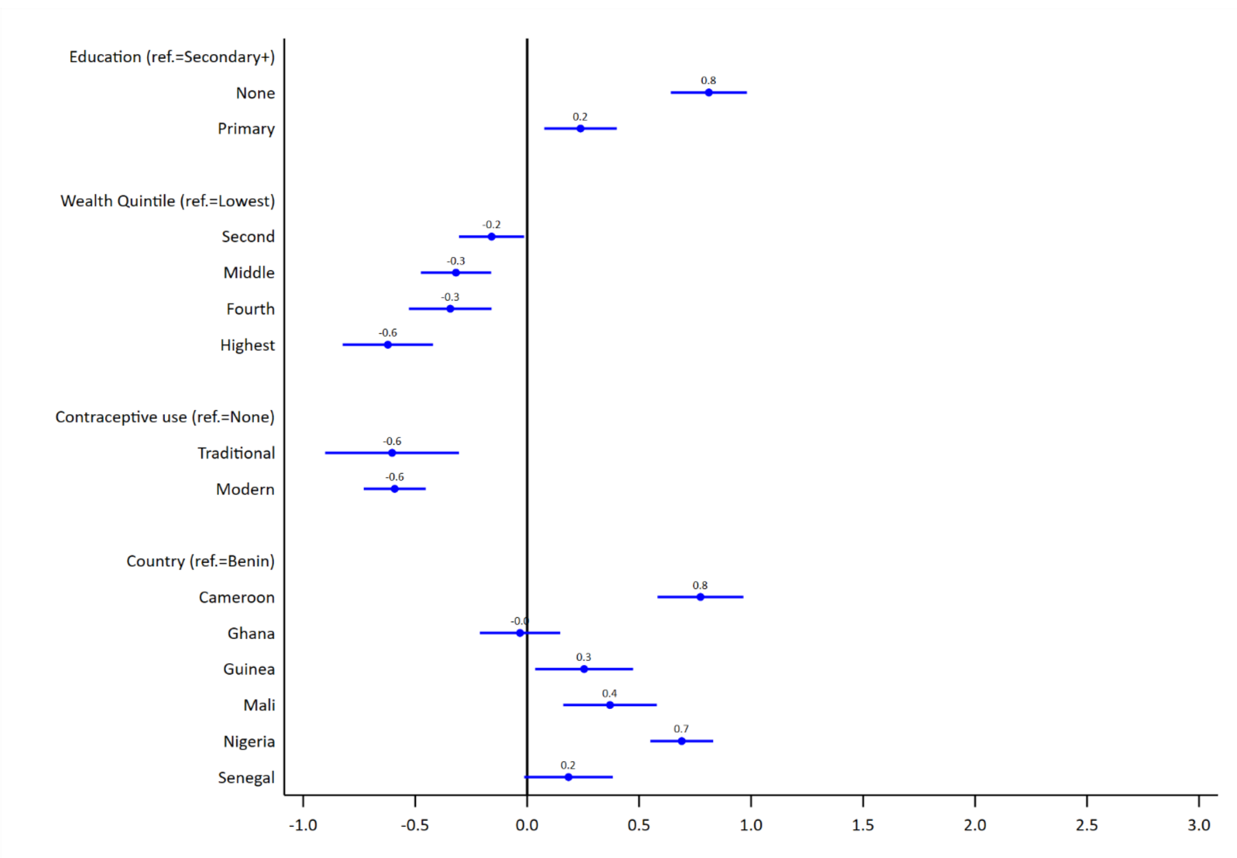


Figure 12 summarizes the regression coefficients from the adjusted logistic regression of unrealized fertility in Western and Central Africa for the fertility-related variables among women age 40-49. For Model 1, we see that having fewer than 4 children has a higher likelihood of unrealized fertility compared to having 4 children, while having more than 4 children has a lower likelihood of unrealized fertility. This indicates that the ideal number of children for women in this region is 4 children. In Model 2, we see that having fewer than 2 sons or 2 daughters increases the women's likelihood of unrealized fertility, while having more than 2 children decreases the likelihood compared to women with 2 sons or daughters. There were also essentially no differences between the coefficients for number of sons and number of daughters, which implied no sex preference. This again supports the finding from Model 1 that the ideal is 4 children and more specifically, 2 sons and 2 daughters. These results are also supported by the findings in Model 3, which shows that having fewer than 4 children increases the likelihood of unrealized fertility compared to women who have 2 sons and 2 daughters. There was no significant difference in unrealized fertility for women who have 4 children and more daughters than sons compared to having 2 sons and 2 daughters. Having 4 children and more sons than daughters had a marginally higher significance in unrealized fertility compared to women who have 2 sons and 2 daughters (coefficient 0.29, $p<0.05$) (see Appendix Table 7). Having 5 or more children decreased the likelihood of unrealized fertility compared to women who have 2 sons and 2 daughters. Again, having more sons or daughters among women who have 5 children differed greatly with almost equal coefficients for both categories. In summary, these findings indicate that having

4 children in this region is the ideal, and the sex of the child does not appear to be as important as the number of children.

The country-specific results shown in Appendix Table 7 for this region do not differ greatly from the regional results. The adjusted odds ratios for the country-specific results highlighted in blue had a different significance result compared to the regional models. Most of the differences are in the sex composition results, where several countries show that women who have 5 children, regardless of whether they have more sons or more daughters, did not differ significantly in unrealized fertility compared to women with 2 sons and 2 daughters. In Mali, women who have 4 children and more sons than daughters have four times the odds (coefficient 1.4, $p<0.01$) of having unrealized fertility compared to women who have 2 sons and 2 daughters. At the same time, there was no significant difference between women who have 4 children and more daughters than sons compared to women with 2 sons and 2 daughters. This implies some favorability to having at least 2 daughters in Mali. In Cameroon, on the other hand, we see the same pattern for women with 4 children but for the opposite sex and favorability to having at least 2 sons, although the significance was marginal ($p<0.05$). There is also some evidence of sex preferences in Ghana and Guinea with lower likelihood of unrealized fertility for the different sex compositions among women with 5 children, but this finding was also of marginal significance.

Figure 13 Adjusted logistic regression coefficients of unrealized fertility for the control variables in women age 40-49 in Western and Central Africa



In Figure 13, we see that the likelihood of unrealized fertility increased with a decreasing education level and decreased with an increasing wealth quintile for women age 40-49 in Western and Central Africa. Using any type of contraception (traditional or modern) decreased the likelihood of unrealized fertility compared to women who do not use a method. This is expected because women who have unrealized fertility would be trying to become pregnant and therefore not be using a contraceptive method. The figure also shows some variations by country, with women from Cameroon, Guinea, Mali, and Nigeria having a higher likelihood of unrealized fertility compared to women from Benin. There was no significant difference in unrealized fertility between women in Benin and women in Ghana or Senegal. We see some country-specific variations in these variables as shown in Appendix Table 7. In Guinea and Mali, for example, the wealth quintile was not significant, and in Cameroon and Senegal only women in the highest wealth quintile had a significantly lower unrealized fertility compared to women from the lowest wealth quintile. In several countries, there was no significant difference in unrealized fertility between women with primary and secondary or more education level. Only Guinea had a significantly lower likelihood of unrealized fertility for women who were not exposed to FP messages compared to women who were exposed.

Figure 14 Adjusted logistic regression coefficients of unrealized fertility for the fertility variables in women age 40-49 in Eastern Africa

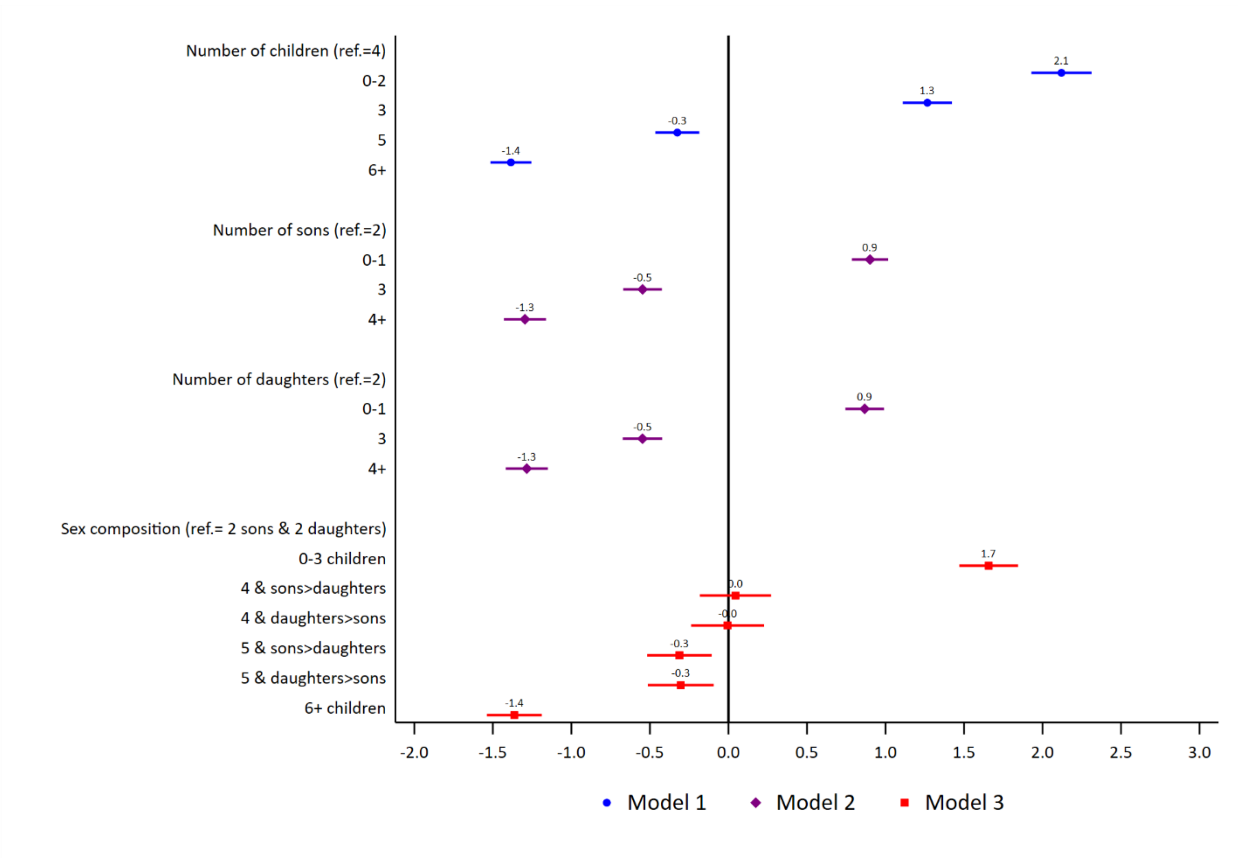
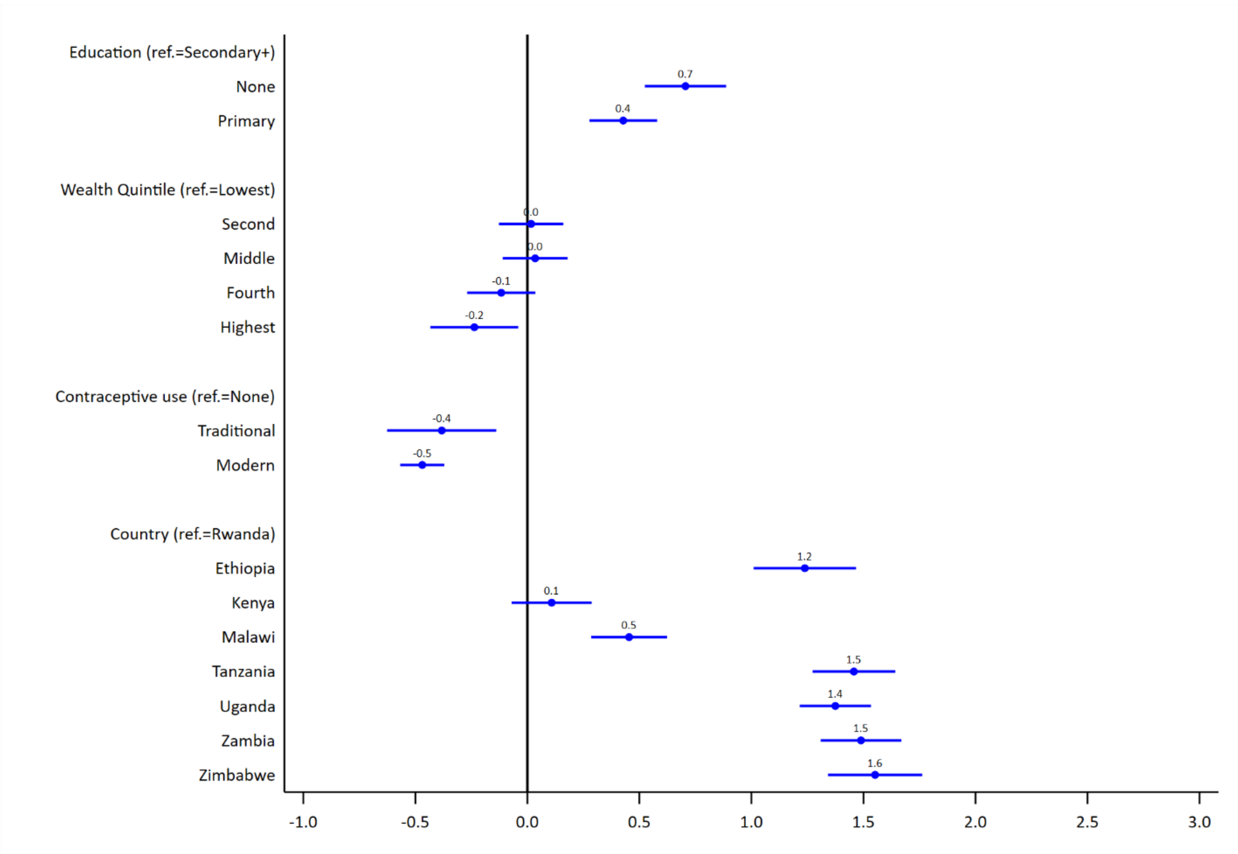


Figure 14 shows the coefficients for the fertility variables in the Eastern Africa region. We observe similar results to the Western and Central Africa region. From examining the results of the three models, we see that having 4 children is the ideal number, with little to no differences by sex of the child. Having fewer than 4 children increased the likelihood of unrealized fertility compared to having 4 children. Having fewer than 2 sons or 2 daughters also increased the likelihood of unrealized fertility compared to having 2 sons or two daughters with similar coefficients (Model 2). In Model 3, we see similar coefficients for women who have more sons or more daughters compared to having 2 sons and 2 daughters, which indicated no observed sex preference. The country-specific results did not differ greatly from the regional results, except that in a few countries there was no significant difference in unrealized fertility between women who have 5 children and women who have 4 children (see Appendix Table 8). There were also no apparent sex preferences except in Ethiopia, Malawi, and Tanzania. In Ethiopia, women with 4 children and more sons than daughters had a greater likelihood of unrealized fertility compared to women with 2 sons and 2 daughters, while having more daughters than sons was not significant, although the significance was marginal (coefficient 0.9, $p<0.05$). There was also some evidence of sex preferences in Malawi and Tanzania among women with 5 children.

Figure 15 Adjusted logistic regression coefficients of unrealized fertility for the control variables in women age 40-49 in Eastern Africa



In Figure 15, we observe that unrealized fertility increases with decreasing education. There were no significant differences in unrealized fertility for women in the second to fourth wealth quintiles compared to women in the lowest wealth quintile. However, women in the highest wealth quintile had significantly lower unrealized fertility compared to women in the lowest wealth quintile. As we have seen in Western and Central Africa, women who use any type of contraceptive method have a lower likelihood of unrealized fertility compared to women who do not use any method. Variations by country were larger in Eastern Africa then in Western and Central Africa. We observe a larger likelihood of unrealized fertility for women in Ethiopia, Malawi, Tanzania, Uganda, Zambia, and Zimbabwe compared to women in Rwanda. There was no significant difference in unrealized fertility between women in Kenya and women in Rwanda. In

Appendix Table 8, we observe that unlike the regional results, for some countries (Ethiopia, Rwanda, and Zimbabwe), education was not significantly associated with unrealized fertility. We also see that in several countries (Ethiopia, Rwanda, Malawi, Uganda, Zambia, and Zimbabwe), women who use a traditional method did not differ significantly from women who used no method.

Figure 16 Adjusted logistic regression coefficients of unrealized fertility for the fertility variables in women age 40-49 in Asia and the Middle East

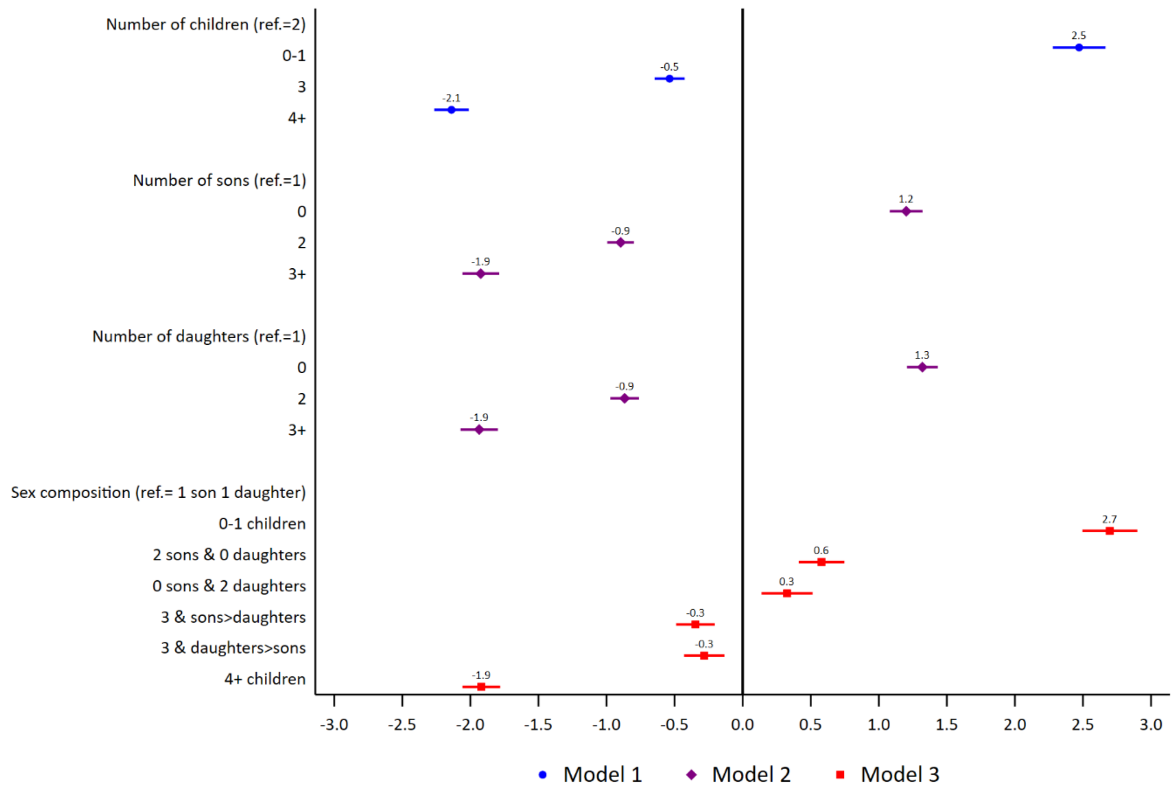
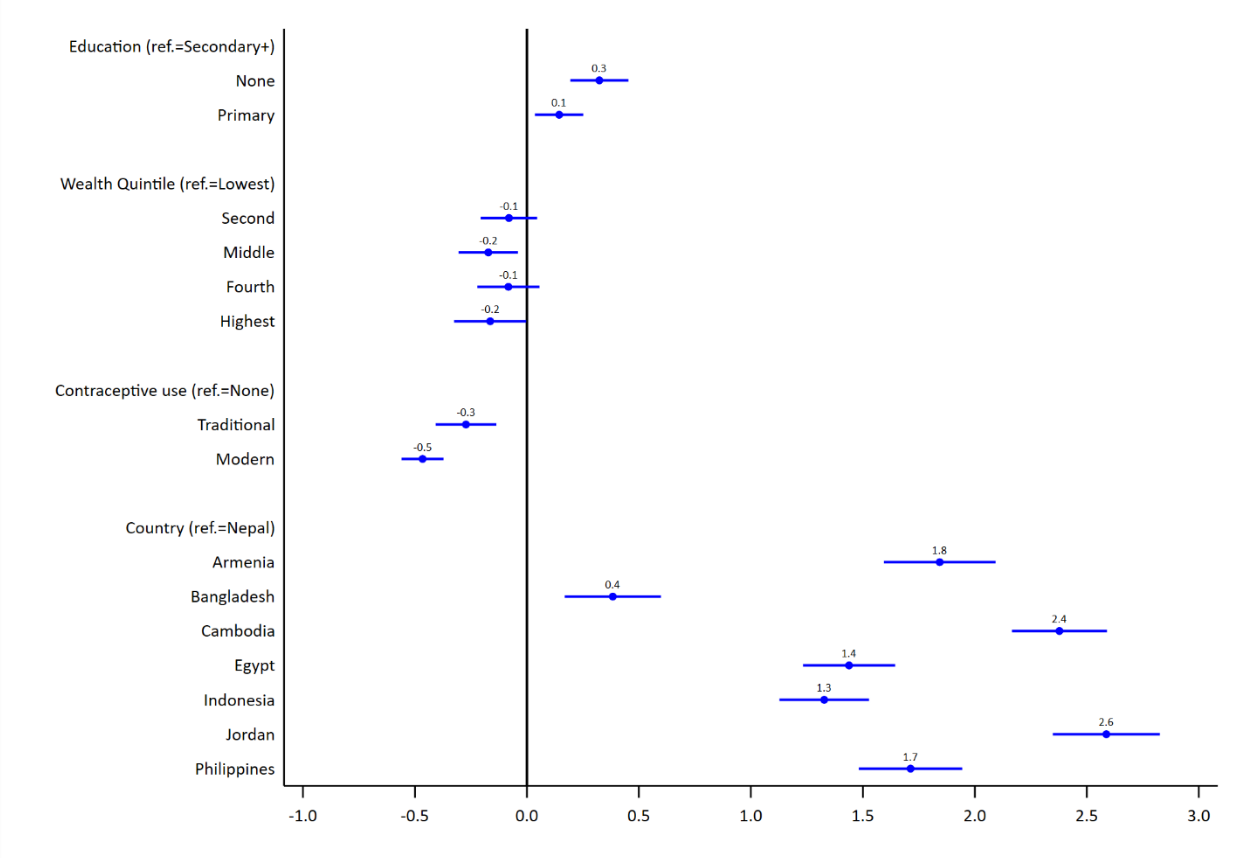


Figure 16 shows the coefficients for the fertility variables in Asian and the Middle East region. As described in the methods, these variables were coded differently compared to the African regions because of the different distributions of number of children. In Model 1, we see that having fewer than 2 children increases the likelihood of unrealized fertility and having more than 2 children decreases the likelihood compared to women with 2 children. In Model 2, we see that having more than 1 son or 1 daughter decreases the likelihood of unrealized fertility, while having no children increases the likelihood of unrealized fertility. In addition, the coefficients for the number of sons and number of daughters were almost identical, which indicated no observed sex preference according to this model. In Model 3, we also see that having fewer than 2 children increases the likelihood of unrealized fertility compared to women with 1 son or 1 daughter. Women who have 2 sons and no daughters have a higher likelihood of unrealized fertility compared to women with 1 son and 1 daughter. Women who have 2 daughters and no sons also had a higher likelihood of unrealized fertility compared to women with 1 son and 1 daughter. However, women with 3 children, regardless of whether they had more sons or more daughters, had a lower likelihood of unrealized fertility. This implies that women prefer not to have more than 2 children but also prefer to have a mix of sexes, and ideally 1 son and 1 daughter. Having four or more children decreases the likelihood even further for unrealized fertility compared to having 1 son and 1 daughter.

The country-specific results did not differ for the number of children, number of sons, or number of daughters as shown in Appendix Table 9. The exception was for Jordanian women with 3 children who did not differ significantly from women with 2 children in unrealized fertility. There were some differences between the countries in the results for the sex composition variable. For Cambodia and Philippines for example, there was no significant difference in unrealized fertility for women who have 2 children regardless of the sex composition, and there was a decreased likelihood of unrealized fertility after having 3 or more children regardless of the sex, which indicated no evidence of sex preferences. For Jordan and Indonesia, there was a decreased likelihood only after having 4 or more children and no apparent sex preferences. For Egypt and Nepal, compared to women with 1 son and 1 daughter, there was a significantly lower likelihood of unrealized fertility for women with 3 children and more sons than daughters but not for women with 3 children and more daughters than sons. In Bangladesh, there was a greater likelihood of unrealized fertility if women had 2 sons and no daughters compared to women with 1 son and 1 daughter, but no significant difference for women with 2 daughters and no sons compared to 1 son and 1 daughter. In Egypt, this significance was marginal and small in magnitude (coefficient -0.4, p<0.05).

Figure 17 Adjusted logistic regression coefficients of unrealized fertility for the control variables in women age 40-49 in Asia and the Middle East



In Figure 17, we see that unrealized fertility increases with decreasing education. However, there were little to no significant differences in unrealized fertility by wealth quintiles. As found with the African regions, women who used any contraceptive method had less likelihood of unrealized fertility compared to women who do not use a method, but this was more for modern users compared to traditional uses. We also observe very large variations by country with all countries in this region having significantly higher unrealized fertility compared to Nepal. However, for Bangladesh, the difference was smaller. In Appendix Table 9, we see that education was not significantly associated with unrealized fertility for several countries (Bangladesh, Egypt, Indonesian, and Jordan). We also observe that in several countries (Armenia, Egypt, Jordan, Nepal, and Philippines), there was no significant difference in unrealized fertility for women who use a traditional method compared to women who do not use a method.

Figure 18 Adjusted logistic regression coefficients of unrealized fertility for the fertility variables in women age 40-49 in Latin America and the Caribbean

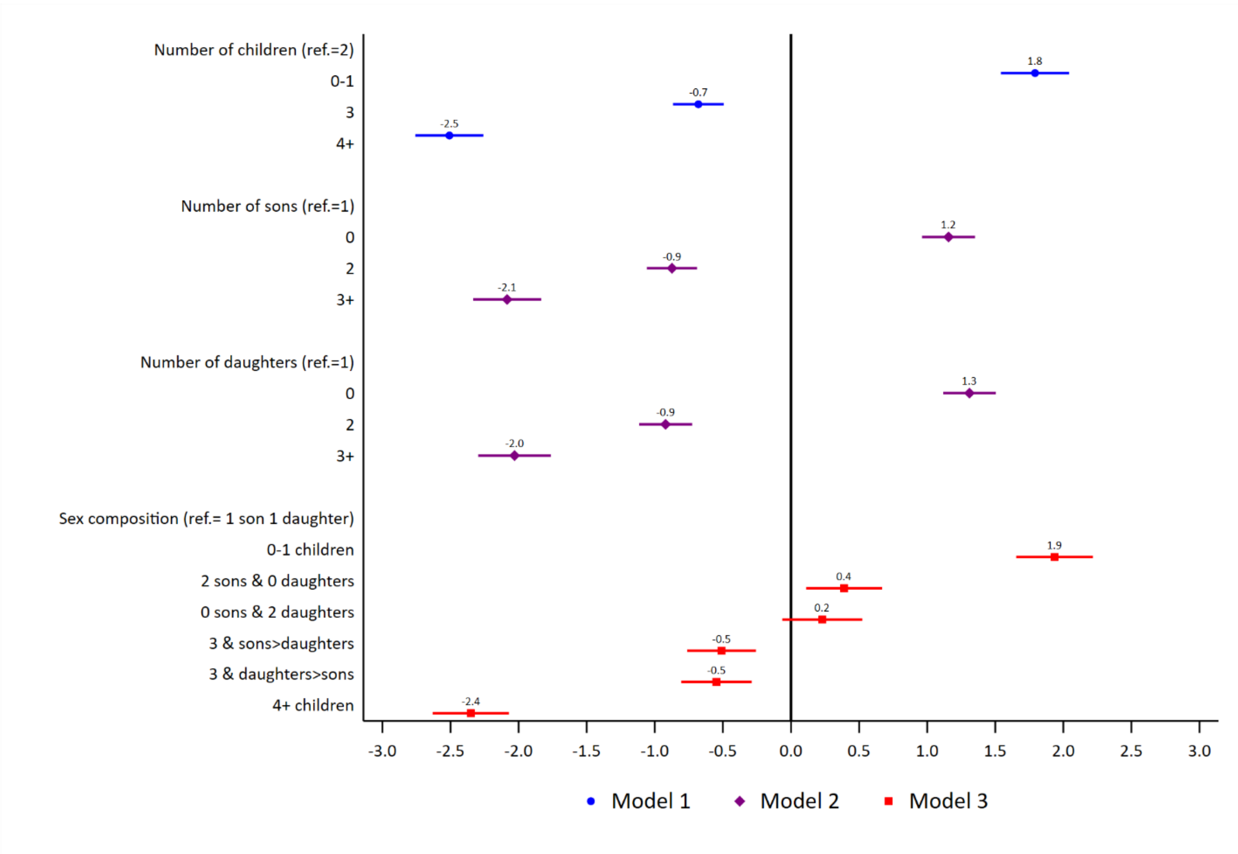
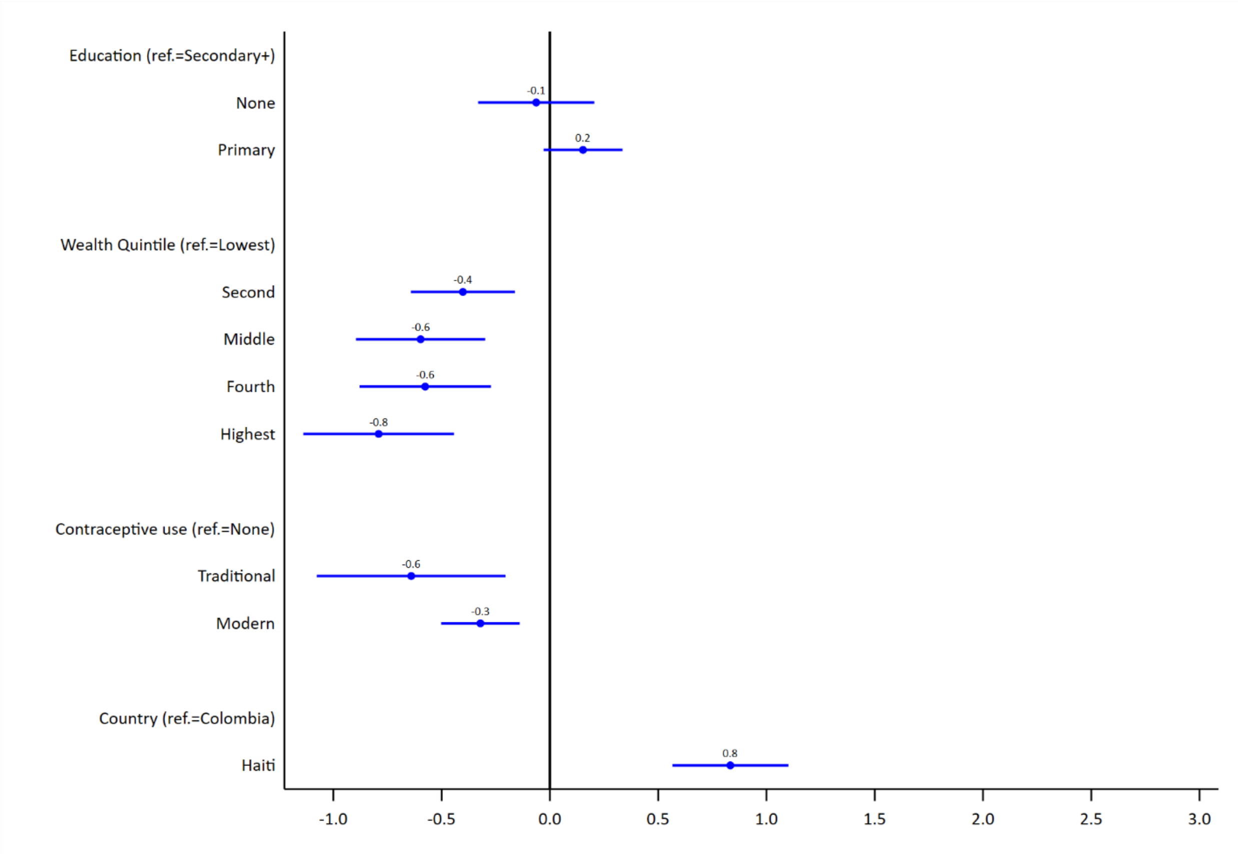


Figure 18 shows the coefficients for the fertility variables in Latin America and the Caribbean. We observe very similar results to the Asia and the Middle East region. From examining the results of the three models, we see that having 2 children is the ideal and, more specifically, having 1 son and 1 daughter. In Model 3, women who have 2 daughters and no sons did not differ significantly in unrealized fertility compared to women with 1 son and 1 daughter. However, there was slighter higher unrealized fertility for women who had 2 sons and no daughters compared to women with 1 son and 1 daughter. (This was only the case in Haiti but not Colombia, as shown in Appendix Table 10.) This implies some favorability to having at least 1 daughter. Women with more than 3 children, regardless of whether they had more sons or more daughters, decreased their likelihood of unrealized fertility. These results imply, as with the other regions, that the sex composition is not as important as the number of children. In this region, women ideally would like to have 2 children and especially 1 son and 1 daughter.

Figure 19 Adjusted logistic regression coefficients of unrealized fertility for the control variables in women age 40-49 in Latin America and the Caribbean



In Figure 19, there are no significant differences in unrealized fertility by education level. Women in the second to highest wealth quintiles have significantly less unrealized fertility compared to women in the lower wealth quintile. Women who use any type of contraceptive method have significantly lower unrealized fertility compared to women who are not using a method. Finally, women in Haiti had significantly higher likelihood of unrealized fertility compared to women in Colombia. In Appendix Table 10, we see that Colombian women with no education had a greater likelihood of unrealized fertility compared to women with secondary or higher education. While wealth quintile was significantly associated with unrealized fertility when the two countries were combined for the regional analysis, this was only the case for Colombia but not Haiti.

4 DISCUSSION AND CONCLUSION

The findings shed light on regional trends in fertility preference, and regional differences in unrealized fertility and unwanted fertility. The findings provide some insights on the factors associated with unrealized fertility. Our findings highlight some differences between regions and specifically between SSA and the other regions. As supported by the literature, this study found that West and Central Africa followed by Eastern Africa have the highest mean ideal number of children and the highest proportions of unrealized fertility compared to the other regions. In Eastern Africa, we also found large regional disparities within the countries. For example, in Kenya and Ethiopia, the highest unrealized fertility reached close to 90% in some regions, which was 66 and 47 percentage points higher respectively than the region with the lowest unrealized fertility. Although we observed slight but significant increases in fertility preferences for the birth cohort we studied, especially in SSA, the magnitude was small. The regression results of unrealized fertility show that in general, women from the African regions want 4 children, while women in the other two regions want 2 children with little evidence of sex preferences. There were some country-specific findings that deviated from the overall regional findings.

Our analysis begins with examining trends in fertility preferences for the birth cohort of women age 40-49. This analysis helps us to understand whether changes in fertility preferences could be a factor in fertility behaviors. While we observed significant changes, the overall change between the first and last survey in the analysis showed an increase of less than one child in the two African regions and less than half a child in the two Latin American and the Caribbean countries. In Asia and the Middle East, there was almost no overall change for the birth cohort analyzed. Country-specific findings corresponded to the regional findings with small magnitudes of change overall and higher increases in fertility preferences (close to one child or below) in the two African regions. We also observe little difference in fertility preferences between boys and girls, and even smaller magnitudes of change in trends of fertility preferences for each sex. It is important to note that while previous research may examine trends in fertility preferences or changes in desired family size overall, our trend analysis concentrates on a specific birth cohort and therefore is not comparable. For example, Westoff (2010) studied the desired number of children among women under age 25 who were not yet married and found declines in the number of desired children, with the exception of some countries in Western and Central Africa. However, a study with a 1979 cohort of women in the U.S. has also found that there was only a slight decrease of approximately 0.3 children in expected fertility size over the women's life course, although changes varied across different subgroups of women (Hayford 2009).

We find that many women have unrealized fertility at the age of 40-49, and more so in the African regions compared to the remaining regions. The analysis has also shown that, in general, the number of children a woman had was more important than the sex of the child in relation to unrealized fertility. We first see this in the distribution of unwanted fertility and unrealized fertility. Unrealized fertility was higher when we look at the total number. When women are asked about sex-specific preferences, there is lower unrealized fertility by sex and few differences between unrealized fertility for boys as compared to girls. The regression results also supported these findings. In Africa, women ideally wanted 4 children, and in the remaining two regions, they ideally wanted 2 children. Having more children than these ideal numbers decreased the likelihood of unrealized fertility, and having fewer children increased the likelihood of unrealized fertility. The association between the sex composition variable and unrealized fertility further supported these findings. In the African regions, women with 5 children with either more sons than daughters or more daughters than sons had a lower likelihood of unrealized fertility compared to women who had 2 sons and 2 daughters. Therefore, the sex composition did not seem to matter while the decreased likelihood of unrealized fertility was due to the number of children.

Some countries did deviate from these findings or had distributions that were very different from the other countries in their assigned region. Since there is a strong association between relationship and reproductive circumstances and fertility preferences (Yeatman, Trinitapoli, and Garver 2020), the deviating country-specific findings could be a result of a country's unique sociocultural or socioeconomic context. For example, Armenia only had 6% of unwanted fertility, 48% of unrealized fertility, and 46% who reached their ideal family size compared to approximately one-third of women in each of these categories for the Asia and the Middle East region. This may be partially explained by the rates of abortions, and possible underreporting of induced abortions in Armenia (Jilozian and Agadjanian 2016), which would give the women the option to abort an unintended pregnancy before birth. In the country-specific regression results for the African regions, we find that in some countries (Benin, Ethiopia, Uganda, Zambia, and Zimbabwe), there was no significant difference in unrealized fertility between women who had 5 children and women who had 4 children. In these countries, the preferred number was 4 or 5 children, while the regional findings show that having 5 children decreased the likelihood of unrealized fertility. In Jordan, women with 3 children did not differ significantly from having 2 children, while in the regional findings, having 2 children appeared to be the ideal. However, most of the remaining countries followed the results from the regional regressions for the number of children. There was some evidence of sex preferences when we observe the country-specific findings, but the significance was usually marginal. One exception was in Mali where the results showed sex preference toward having at least 2 daughters with a large, highly significant coefficient. While there has been evidence of son preference in Mali (Bongaarts 2013; Fuse 2010), the measures used in these studies are not directly comparable to the one used in this report. Here we observe that for women aged 40-49, in Mali there appears to be daughter preference compared to having 2 sons and 2 daughters after reaching a certain number of children from each sex. Another difference between our study and those that identified a sex preference is the inclusion of men or couples. These studies suggest that men might have a stronger preference towards boys (Kastor and Chatterjee 2018; Lamson 2020). The apparent daughter preference in Mali after having two sons and two daughters needs further study.

Many factors can contribute to unrealized fertility. One important factor is infertility and especially secondary infertility, which can be found at higher rates compared to primary infertility (Mascarenhas et al. 2012). Since we are studying women age 40-49, infertility levels can be relatively high. A study of 277 countries with DHS data has found that secondary infertility ranged between 4%-22% (Mascarenhas et al. 2012) and several studies have found that women of advanced age were more likely to experience infertility (Direkvand-Moghadam, Delpisheh, and Khosravi 2013). We also find that economic constraints can be an important factor, since in many countries, women from high wealth quintiles decreased their likelihood of unrealized fertility compared to the lowest quintile. This could imply that wealthier women were able to have or exceed their ideal number of children compared to women from the lowest wealth quintile. Studies suggest that fertility behavior is influenced by socioeconomic factors and changes in both macro and micro economic factors (Buckles, Hungerman, and Lugauer 2021; Simon 2019). Further, women from higher wealth quintiles are better able to mitigate their fertility intentions through delayed marriage and modest increases in contraceptive use (Finlay, Mejía-Guevara, and Akachi 2018). In addition, women who had lower than secondary education were more likely to have unrealized fertility. Several studies have found that women from lower education levels have higher unwanted fertility and pregnancies (Ameyaw et al. 2019; Bennett et al. 2006; Bongaarts 2010; Nyarko 2019). The results that show women with lower education also have high unrealized fertility are driven by the high fertility preferences for women with lower education. Further analysis of the data has shown that women with no or primary education do have higher levels of unrealized and unwanted fertility compared to women with secondary education in the Western and Central Africa region. For the remaining regions, the lower education groups had higher unwanted fertility but not higher unrealized fertility (see Table 3). This is supported by the regression results that show a weaker association between education and unrealized fertility in Asia and the Middle East and Latin America and the Caribbean compared to the African regions. Channon and Harper (2019) also found a weak or inconsistent association between unrealized fertility and education in most countries in their analysis, and that unrealized fertility was common among all education levels in SSA.

Table 3 Cross-tabulation of education by ideal minus current number of children for each region

	Unwanted fertility (ideal<current)	Ideal=current	Unrealized fertility (ideal>current)
Western & Central Africa			
None	22.3	13.8	63.9
Primary	24.7	18.6	56.7
Secondary+	17.4	21.0	61.6
Eastern Africa			
None	36.6	15.7	47.8
Primary	36.9	18.4	44.7
Secondary+	21.0	22.5	56.4
Asia and the Middle East			
None	50.7	29.7	19.6
Primary	36.3	34.4	29.3
Secondary+	24.6	39.7	35.7
Latin America and the Caribbean			
None	59.9	14.5	25.7
Primary	43.9	25.5	30.6
Secondary+	24.3	34.6	41.2

Other factors that were not examined in this study could also be linked to the partner's desires, community factors, or other hidden individual preferences and factors. Women may be postponing having the children they want due to many individual factors not measured in DHS data. This postponement could also lead to women never reaching that ideal. It is also possible for women to report an ideal they do not expect to achieve due to various circumstances. The reasons for postponement of childbirth or the decision to remain childless were found to be linked to women's prioritizing education and career aspirations, the search for the right partner, value changes, female empowerment, and the absence of supportive family policies (Beaujouan and Sobotka 2019; Martin 2020; Mills et al. 2011; Solanke et al. 2019; Vichinsartvichai, Limvorapitux, and Traipak 2019).

This study has some limitations. First, since the data are self-reported, it is possible that women are more likely to report the number of children they have as their ideal by rationalizing the ideal number of children. Rationalization is also expected to be higher in older women, who are the focus of this analysis. This rationalization could also be higher when asked about ideal number of children of each sex, because women may not want to appear biased. This could be one explanation for the limited evidence of sex preferences. However, the results still show lower proportions of women reporting that they reached their ideal number of children, and reporting the number of children they have, compared to women with unrealized or unwanted fertility.

Another limitation to studying sex preferences is the numerous possible combinations of sons and daughters. Extreme distributions, such as couples who have all sons or all daughters, have sample size limitations for the analysis. The larger percentages of non-numeric responses for ideal number of children for certain countries could have also biased the results since they were excluded from the analysis. Since there were few countries with available data for each region, generalizing the results to the entire region should be done with caution. This is especially relevant for the Latin America and Caribbean region. We have combined countries from Western Asia (Armenia), the Middle Eastern countries (Egypt and Jordan), and Southeast Asia, which can have very different fertility behaviors and preferences. Country-specific results were discussed to highlight these differences when large differences were detected. Finally, the fertility preferences of the women's partner/husband were not considered in this analysis. Since the man's decision can also affect fertility behaviors and preferences, men's preferences are an important factor that should be examined. Future research should also consider examining men's ideal number of children and how that number corresponds to the ideal number reported by their partners.

From a reproductive rights perspective, we would like women to achieve the ideal number of children they want. However, at the same time, population and reproductive programs have worked toward promoting smaller family sizes through FP to promote women's and child's health. Increases in contraceptive use not only reduce unintended pregnancies, high-risk pregnancies, and maternal and infant mortality, but also have been found to improve schooling and economic outcomes, both at the individual and macro levels (United Nations Department of Economic and Social Affairs Population Division 2020). The results have shown that in general, women in Asia and the Middle East and Latin America and the Caribbean want to reach replacement-level fertility. Women in these regions ideally want 2 children and evidence shows that several countries in these regions have high levels of unwanted fertility (see Figure 11). In the African regions, the ideal number of children was 4 or higher, which was double the replacement level. Women in Africa want large families even in later stages of fertility. Therefore, fertility and reproductive health policies should consider these differences in regional patterns.

To successfully promote and achieve smaller family sizes that are close to replacement levels, interventions are required to both decrease fertility preferences and emphasize FP. In the trend analysis, we found that fertility preferences did not decrease and, in fact, increased slightly for the birth cohort we studied. Interventions for reducing fertility preference size may therefore be required in the African regions (Bongaarts and Casterline 2013). Evidence has shown that FP programs can be successful in reducing desired family size (Bongaarts 2011). Controlling family size through FP was found to be important in all regions. Women who used a contraception method had a reduced likelihood of unrealized fertility because they are using contraception to control their family size after reaching their ideal number of children. At the same time, we found that, for the most part, FP messages were not an important factor in unrealized fertility. This has implications for the FP messaging and how it can affect fertility preferences and behaviors. Future research is also needed on the impact of men's fertility preferences on fertility behavior, which can be another important factor for achieving sustainable fertility levels.

REFERENCES

Ameyaw, E. K., E. Budu, F. Sambah, L. Baatiema, F. Appiah, A-A. Seidu, and B. O. Ahinkorah. 2019. “Prevalence and Determinants of Unintended Pregnancy in Sub-Saharan Africa: A Multi-Country Analysis of Demographic and Health Surveys.” *PLOS ONE* 14 (8): 1-16. https://doi.org/10.1371/journal.pone.0220970.

Barden-O'Fallon, J. 2005. “Unmet Fertility Expectations and the Perception of Fertility Problems in a Malawian Village.” *African Journal of Reproductive Health* 9 (2): 14-25. https://doi.org/10.2307/3583459.

Beaujouan, É., and T. Sobotka. 2019. “Late Childbearing Continues to Increase in Developed Countries.” *Population & Societies* 562 (1): 1-4. https://doi.org/10.3917/popsoc.562.0001.

Bennett, I. M., J. F. Culhane, K. F. McCollum, and I. T. Elo. 2006. “Unintended Rapid Repeat Pregnancy and Low Education Status: Any Role for Depression and Contraceptive Use?” *American Journal of Obstetrics and Gynecology* 194 (3): 749-754. https://doi.org/10.1016/j.ajog.2005.10.193.

Billari, F. C., H.-P. Kohler, G. Andersson, and H. Lundström. 2007. “Approaching the Limit: Long-Term Trends in Late and Very Late Fertility.” *Population and Development Review* 33 (1): 149-170. https://doi.org/10.1016/j.ajog.2005.10.193.

Bongaarts, J. 1978. “A Framework for Analyzing the Proximate Determinants of Fertility.” *Population and Development Review* 4 (1): 105-132. https://doi.org/10.2307/1972149.

Bongaarts, J. 2001. “Fertility and Reproductive Preferences in Post-Transitional Societies.” *Population and Development Review* 27: 260-281. https://www.jstor.org/stable/3115260.

Bongaarts, J. 2010. “The Causes of Educational Differences in Fertility in Sub-Saharan Africa.” *Vienna Yearbook of Population Research* 8 (1): 31-50. https://doi.org/10.1553/populationyearbook2010s31.

Bongaarts, J. 2011. “Can Family Planning Programs Reduce High Desired Family Size in Sub-Saharan Africa?” *International Perspectives on Sexual and Reproductive Health* 37 (4): 209-216. https://www.guttmacher.org/sites/default/files/pdfs/pubs/journals/3720911.pdf.

Bongaarts, J. 2013. “The Implementation of Preferences for Male Offspring.” *Population and Development Review* 39 (2): 185-208. https://doi.org/10.1111/j.1728-4457.2013.00588.x.

Bongaarts, J., and J. Casterline. 2013. “Fertility Transition: Is Sub-Saharan Africa Different?” *Population and Development Review* 38 (Suppl 1): 153-168. https://doi.org/10.1111/j.1728-4457.2013.00557.x.

Buckles, K., D. Hungerman, and S. Lugauer. 2021. “Is Fertility a Leading Economic Indicator?” *The Economic Journal* 131 (634): 541-565. https://doi.org/10.1093/ej/ueaa068.

Casterline, J. B., and S. Han. 2017. “Unrealized Fertility: Fertility Desires at the End of the Reproductive Career.” *Demographic Research* 36 (14): 427-454. https://www.demographic-research.org/volumes/vol36/14/36-14.pdf.

Channon, M. D., and S. Harper. 2019. “Educational Differentials in the Realisation of Fertility Intentions: Is Sub-Saharan Africa Different?” *PLOS ONE* 14 (7): 1-14. https://doi.org/10.1371/journal.pone.0219736.

Cleland, J., K. Machiyama, and J. B. Casterline. 2020. “Fertility Preferences and Subsequent Childbearing in Africa and Asia: A Synthesis of Evidence from Longitudinal Studies in 28 Populations.” *Population Studies* 74 (1): 1-21. https://doi.org/10.1080/00324728.2019.1672880.

Direkvand-Moghadam, A., A. Delpisheh, and A. Khosravi. 2013. “Epidemiology of Female Infertility; a Review of Literature.” *Biosciences Biotechnology Research Asia* 10 (2): 559-67. http://dx.doi.org/10.13005/bbra/1165.

Fayehun, O., O. A. Sanuade, A. I. Ajayi, and U. Isiugo-Abanihe. 2020. “Ethnicity, Sex Composition of Living Children, and Unrealized Fertility in Nigeria.” *Population Studies* 74 (3): 351-361. https://doi.org/10.1080/00324728.2020.1779333.

Filmer, D., J. Friedman, and N. Schady. 2009. “Development, Modernization, and Childbearing: The Role of Family Sex Composition.” *The World Bank Economic Review* 23 (3): 371-398. https://doi.org/10.1093/wber/lhp009.

Finlay, J. E., I. Mejía-Guevara, and Y. Akachi. 2018. “Inequality in Total Fertility Rates and the Proximate Determinants of Fertility in 21 Sub-Saharan African Countries.” *PLOS ONE* 13 (9): e0203344. https://doi.org/10.1371/journal.pone.0203344.

Fuse, K. 2010. “Variations in Attitudinal Gender Preferences for Children across 50 Less-Developed Countries.” *Demographic Research* 23 (36): 1031-1048. https://www.jstor.org/stable/pdf/26349621.pdf.

Girum, T., and A. Wasie. 2017. “Correlates of Maternal Mortality in Developing Countries: An Ecological Study in 82 Countries.” *Maternal Health, Neonatology and Perinatology* 3 (1): 19. https://doi.org/10.1186/s40748-017-0059-8.

Hayford, S. R. 2009. “The Evolution of Fertility Expectations over the Life Course.” *Demography* 46 (4): 765-783. https://doi.org/10.1353/dem.0.0073.

Jayaraman, A., V. Mishra, and F. Arnold. 2009. “The Relationship of Family Size and Composition to Fertility Desires, Contraceptive Adoption and Method Choice in South Asia.” *International Perspectives on Sexual and Reproductive Health* 35 (1): 29-38. https://www.guttmacher.org/sites/default/files/article_files/3502909.pdf.

Jilozian, A., and V. Agadjanian. 2016. “Is Induced Abortion Really Declining in Armenia?” *Studies in Family Planning* 47 (2): 163-178. https://doi.org/10.1111/j.1728-4465.2016.00053.x.

Kastor, A., and S. Chatterjee. 2018. “Impact of Sex Composition of Living Children and Couples' Agreement on Subsequent Fertility in India.” *Journal of Biosocial Science* 50 (5): 666-682. https://doi.org/10.1017/S0021932017000578.

Lamson, L. 2020. *The Effect of Sex of Firstborn Children on Fertility Preferences*. Master's Thesis, Department of Economics, University of San Francisco, San Francisco, CA, USA. https://repository.usfca.edu/thes/1313.

Majumder, N., and F. Ram. 2015. “Explaining the Role of Proximate Determinants on Fertility Decline among Poor and Non-Poor in Asian Countries.” *PLOS ONE* 10 (2): e0115441. https://doi.org/10.1371/journal.pone.0115441.

Martin, L. J. 2020. “Delaying, Debating and Declining Motherhood.” *Culture, Health & Sexuality*: 1-16. https://doi.org/10.1080/13691058.2020.1755452.

Mascarenhas, M. N., S. R. Flaxman, T. Boerma, S. Vanderpoel, and G. A. Stevens. 2012. “National, Regional, and Global Trends in Infertility Prevalence since 1990: A Systematic Analysis of 277 Health Surveys.” *PLOS Medicine* 9 (12): e1001356. https://doi.org/10.1371/journal.pmed.1001356.

Mills, M., R. R. Rindfuss, P. McDonald, and E. te Velde. 2011. “Why Do People Postpone Parenthood? Reasons and Social Policy Incentives.” *Human Reproduction Update* 17 (6): 848-860. https://doi.org/10.1093/humupd/dmr026.

Nitsche, N., and S. R. Hayford. 2020. “Preferences, Partners, and Parenthood: Linking Early Fertility Desires, Marriage Timing, and Achieved Fertility.” *Demography* 57 (6): 1975-2001. https://doi.org/10.1007/s13524-020-00927-y.

Nyarko, S. H. 2019. “Unintended Pregnancy among Pregnant Women in Ghana: Prevalence and Predictors.” *Journal of Pregnancy* 2019: 1-8. https://doi.org/10.1155/2019/2920491.

Rossi, P., and L. Rouanet. 2015. “Gender Preferences in Africa: A Comparative Analysis of Fertility Choices.” *World Development* 72: 326-345. 10.1016/j.worlddev.2015.03.010.

Rutstein, S., and R. Winter. 2015. *Contraception Needed to Avoid High-Fertility-Risk Births, and Maternal and Child Deaths That Would Be Averted*. DHS Analytical Studies No. 50. Rockville, Maryland, USA: ICF International. http://dhsprogram.com/pubs/pdf/AS50/AS50.pdf.

Searchinger, T., C. Hanson, R. Waite, B. Lipinski, G. Leeson, and S. Harper. 2013. *Achieving Replacement Level Fertility*. Working Paper, Installment 3 of “*Creating a Sustainable Food Future*.” Washington, DC, USA: World Resources Institute. https://www.wri.org/research/achieving-replacement-level-fertility.

Simon, J. L. 2019. “The Economics of Population Growth.” Chapter 15 in *The Short-Run and Long-Run Effects of Income on Fertility in MDC's*, 329-352. Princeton, NJ, USA: Princeton University Press. https://doi.org/10.1515/9780691197654-026.

Solanke, B. L., O. R. Salau, O. E. Popoola, M. O. Adebiyi, and O. O. Ajao. 2019. “Socio-Demographic Factors Associated with Delayed Childbearing in Nigeria.” *BMC Research Notes* 12 (1): 1-8. https://doi.org/10.1186/s13104-019-4414-x.

Spéder, Z., and B. Kapitány. 2009. “How Are Time-Dependent Childbearing Intentions Realized? Realization, Postponement, Abandonment, Bringing Forward.” *European Journal of Population* 25 (4): 503-523. https://doi.org/10.1007/s10680-009-9189-7.

United Nations Department of Economic and Social Affairs Population Division. 2020. *World Fertility and Family Planning 2020. Highlights*: *Accelerating Action to Ensure Universal Access to Family Planning (ST/ESA/SER.A/450)*. New York, USA: United Nations. https://www.un.org/development/desa/pd/content/world-fertility-and-family-planning-2020-highlights.

Vichinsartvichai, P., P. Limvorapitux, and K. Traipak. 2019. “What Took You So Long? A Public Health Approach to Mitigate the Delayed Childbearing.” *Fertility & Reproduction* 1 (4): 180-186. https://doi.org/10.1142/S2661318219500208.

Westoff, C. F. 2010. *Desired Number of Children: 2000-2008*. DHS Comparative Reports No. 25. Calverton, Maryland, USA: ICF Macro. https://www.dhsprogram.com/pubs/pdf/CR25/CR25.pdf.

Yeatman, S., J. Trinitapoli, and S. Garver. 2020. “The Enduring Case for Fertility Desires.” *Demography* 57 (6): 2047-2056. https://doi.org/10.1007/s13524-020-00921-4.

APPENDIX

Appendix Table 1 Percent distribution of ideal number of children and mean ideal number of children for women age 40-49 in the most recent survey for each country

Region	Country	None	1-2	3-4	5-6	7-8	9-10	11-19	20+	Non-numeric	Total	Mean
Western and Central Africa	Benin	4.4	3.4	24.5	31.3	15.6	10.3	3.5	0.0	7.0	100.0	5.9
	Cameroon	1.2	3.0	19.0	30.4	15.3	13.3	4.8	0.7	12.4	100.0	6.4
	Ghana	0.9	5.4	40.4	32.3	7.8	7.5	1.2	0.1	4.3	100.0	5.1
	Guinea	7.4	1.9	11.3	27.3	18.0	10.7	1.6	0.4	21.4	100.0	5.9
	Mali	2.6	3.2	12.1	24.6	20.9	16.2	4.3	0.2	15.8	100.0	6.7
	Nigeria	4.3	1.4	21.1	28.1	13.6	16.8	11.0	0.1	3.5	100.0	6.7
	Senegal	0.2	4.1	20.3	31.2	16.6	7.9	1.0	0.0	18.8	100.0	5.8
Eastern Africa	Ethiopia	9.8	3.1	20.3	20.3	14.6	9.3	4.0	0.3	18.4	100.0	5.7
	Kenya	1.0	17.8	47.0	20.0	5.5	3.9	1.3	0.2	3.2	100.0	4.3
	Malawi	3.0	7.8	41.5	31.9	7.8	3.8	0.7	0.0	3.5	100.0	4.7
	Rwanda	1.1	15.5	53.8	18.5	4.0	2.9	1.5	0.1	2.6	100.0	4.1
	Tanzania	1.2	3.5	27.2	34.9	13.1	10.4	2.4	0.3	7.0	100.0	5.8
	Uganda	1.0	3.4	26.8	35.2	14.2	9.9	3.7	0.5	5.2	100.0	6.1
	Zambia	1.4	4.0	24.0	37.7	16.3	10.5	2.2	0.1	3.8	100.0	5.9
	Zimbabwe	1.1	9.9	39.8	34.0	6.8	6.0	1.3	0.2	0.9	100.0	4.9
Asia and the Middle East	Armenia	1.1	41.1	54.9	1.7	0.1	0.1	1.0	0.0	1.0	100.0	2.8
	Bangladesh	0.1	61.5	35.2	1.3	0.2	0.1	0.0	0.0	1.6	100.0	2.5
	Cambodia	1.6	17.3	52.7	23.4	2.0	0.7	0.0	0.0	2.2	100.0	3.8
	Egypt	0.6	32.0	49.2	9.5	1.2	1.1	0.3	0.0	6.0	100.0	3.3
	Indonesia	1.1	48.7	32.6	6.0	0.9	0.2	0.1	0.0	10.4	100.0	2.8
	Jordan	6.7	12.8	46.5	27.2	3.3	1.8	0.5	0.2	1.2	100.0	4.1
	Nepal	1.7	61.6	34.6	1.3	0.1	0.0	0.1	0.0	0.6	100.0	2.4
	Philippines	2.7	33.7	50.0	11.2	1.1	0.7	0.3	0.0	0.3	100.0	3.1
Latin America and the Caribbean	Colombia	4.9	53.5	31.9	6.7	0.9	0.7	0.5	0.1	0.8	100.0	2.6
	Haiti	0.7	31.3	54.0	10.7	1.2	1.7	0.2	0.0	0.2	100.0	3.4

Note: Mean does not include non-numeric response.

Appendix Table 2 Among women age 15-49, the percentage of women who had a birth between age 40-49 in the most recent survey for each country

Region	Country	% [95 C.I.]	Number of women age 15-49	Number of women age 40-49
Western and Central Africa	Benin	4.3 [3.9, 4.6]	15,928	2,585
	Cameroon	2.3 [2.0, 2.7]	13,616	1,993
	Ghana	3.7 [3.3, 4.2]	9,396	1,887
	Guinea	4.4 [4.0, 4.8]	10,874	1,854
	Mali	4.3 [3.8, 4.8]	10,519	1,520
	Nigeria	4.2 [4.0, 4.5]	41,821	7,642
	Senegal	4.2 [3.6, 4.9]	9,414	1,542
	Ethiopia	3.3 [2.9, 3.8]	15,683	2,306
Eastern Africa	Kenya	2.4 [2.2, 2.6]	31,079	5,142
	Malawi	3.1 [2.8, 3.4]	24,562	3,596
	Rwanda	4.2 [3.8, 4.5]	13,497	2,246
	Tanzania	4.3 [3.9, 4.7]	13,266	2,361
	Uganda	3.6 [3.3, 3.9]	18,506	2,814
	Zambia	3.7 [3.4, 4.2]	13,683	2,153
	Zimbabwe	1.9 [1.6, 2.3]	9,955	1,548
Asia and the Middle East	Armenia	0.3 [0.2, 0.5]	6,116	1,490
	Bangladesh	0.5 [0.4, 0.6]	20,127	4,581
	Cambodia	2.0 [1.7, 2.2]	17,578	3,947
	Egypt	1.8 [1.6, 2.0]	21,762	5,568
	Indonesia	2.1 [1.9, 2.2]	49,627	13,748
	Jordan	4.0 [3.6, 4.5]	14,689	4,936
	Nepal	0.7 [0.5, 0.9]	12,862	2,501
	Philippines	2.6 [2.3, 2.9]	25,074	5,682
Latin America and the Caribbean	Colombia	1.0 [0.8, 1.1]	36,300	8,633
	Haiti	3.0 [2.7, 3.4]	14,371	2,435

Appendix Table 3 Trends in the ideal number of children (Total, Boys, Girls)

	Mean ideal number of children - Total								Mean ideal number of children - Boys							
Country	sur 1	sur 2	diff. 2-1	sur 3	diff. 3-2	sur 4	diff 4-3	diff 4-1	sur 1	sur 2	diff. 2-1	sur 3	diff. 3-2	sur 4	diff 4-3	diff 4-1
Western and Central Africa	5.37	5.73	0.36***	6.05	0.32***	6.02	-0.03	0.65***	2.43	2.51	0.08*	2.57	0.06	2.70	0.13***	0.27***
Benin	4.95	5.19	0.24**	5.03	-0.16*	5.87	0.84***	0.92***	1.99	2.07	0.08	2.30	0.23***	2.21	-0.09	0.22**
Cameroon	5.62	5.85	0.23	6.20	0.35**	6.44	0.24	0.82***	2.29	2.01	-0.28***	2.27	0.26***	2.65	0.38***	0.36***
Ghana	4.20	4.73	0.53***	4.76	0.03	5.14	0.38***	0.94***	2.01	2.06	0.05	2.00	-0.06	2.08	0.08	0.07
Guinea	5.48	5.94	0.46***	6.33	0.39***	5.94	-0.39*	0.46**	2.81	2.68	-0.13*	2.75	0.07	2.95	0.2*	0.14
Mali	6.08	6.65	0.57**	6.24	-0.41*	6.71	0.47***	0.63***	2.77	3.35	0.58***	2.88	-0.47**	3.19	0.31***	0.42***
Nigeria	6.74	6.47	-0.27	7.12	0.65***	6.73	-0.39***	-0.01	3.06	2.76	-0.3***	2.41	-0.35***	2.61	0.2***	-0.45***
Senegal	5.46	5.38	-0.08	5.49	0.11	5.79	0.3*	0.33*	2.84	2.87	0.03	2.94	0.07	3.16	0.22*	0.32***
Eastern Africa	4.49	4.82	0.33***	4.97	0.15***	5.26	0.29***	0.77***	1.89	2.10	0.21***	2.12	0.02	2.23	0.11***	0.34***
Ethiopia	5.44	5.14	-0.3*	5.38	0.24	5.66	0.28	0.22	2.72	2.61	-0.11	2.71	0.1	2.83	0.12	0.11
Kenya	3.63	4.08	0.45***	4.15	0.07	4.29	0.14	0.66***	1.44	1.55	0.11*	1.60	0.05	1.61	0.01	0.17***
Malawi	4.32	4.55	0.23***	4.85	0.3***	4.70	-0.15*	0.38***	1.91	2.00	0.09*	2.19	0.19***	2.12	-0.07	0.21***
Rwanda	4.64	4.36	-0.28***	3.96	-0.4***	4.14	0.18**	-0.5***	2.03	1.87	-0.16***	1.59	-0.28***	1.61	0.02	-0.42***
Tanzania	5.12	5.37	0.25	5.55	0.18	5.81	0.26*	0.69***	NA	2.34	NA	2.11	-0.23***	2.08	-0.03	NA
Uganda	4.89	5.51	0.62***	5.74	0.23*	6.10	0.36***	1.21***	1.98	2.26	0.28***	2.43	0.17**	2.62	0.19**	0.64***
Zambia	4.59	5.04	0.45***	5.51	0.47***	5.88	0.37***	1.29***	1.87	2.02	0.15**	2.30	0.28***	2.60	0.3***	0.73***
Zimbabwe	3.81	4.17	0.36***	4.53	0.36***	4.94	0.41***	1.13***	1.70	1.88	0.18***	1.98	0.1	2.14	0.16**	0.44***
Asia and the Middle East	3.07	2.91	-0.16***	3.10	0.19***	3.01	-0.09***	-0.06**	1.45	1.28	-0.17***	1.40	0.12***	1.31	-0.09***	-0.14***
Armenia	2.57	2.60	0.03	2.65	0.05	2.77	0.12**	0.2***	1.30	1.29	-0.01	1.27	-0.02	1.33	0.06	0.03
Bangladesh	2.42	2.35	-0.07*	2.39	0.04	2.54	0.15***	0.12***	1.12	1.06	-0.06**	0.99	-0.07**	1.13	0.14***	0.01
Cambodia	3.56	3.61	0.05	3.66	0.05	3.77	0.11**	0.21***	1.75	1.69	-0.06*	1.66	-0.03	1.69	0.03	-0.06*
Egypt	2.86	2.93	0.07*	3.08	0.15***	3.27	0.19***	0.41***	1.11	0.92	-0.19***	1.02	0.1***	0.96	-0.06*	-0.15***
Indonesia	2.75	2.78	0.03	2.69	-0.09**	2.77	0.08**	0.02	1.16	1.13	-0.03	1.08	-0.05**	1.09	0.01	-0.07**
Jordan	4.10	3.88	-0.22**	4.07	0.19**	4.05	-0.02	-0.05	1.96	1.86	-0.1*	1.77	-0.09	1.97	0.2***	0.01
Nepal	2.57	2.44	-0.13**	2.38	-0.06	2.40	0.02	-0.17***	1.41	1.32	-0.09*	1.26	-0.06	1.24	-0.02	-0.17***
Philippines	3.03	3.14	0.11**	3.17	0.03	3.14	-0.03	0.11**	1.39	1.41	0.02	1.37	-0.04	1.37	0.00	-0.02
Latin America and the Caribbean	2.60	2.73	0.13**	2.81	0.08*	3.00	0.19***	0.4***	1.01	1.11	0.1***	1.09	-0.02	1.15	0.06**	0.14***
Colombia	2.20	2.27	0.07**	2.47	0.2***	2.59	0.12***	0.39***	0.77	0.91	0.14***	0.95	0.04*	0.95	0.00	0.18***
Haiti	3.01	3.18	0.17	3.16	-0.02	3.41	0.25***	0.4***	1.26	1.31	0.05	1.23	-0.08*	1.35	0.12**	0.09

Continued...

Appendix Table 3—*Continued*

	Mean ideal number of children - Girls							
Country	**sur 1**	**sur 2**	**diff. 2-1**	**sur 3**	**diff. 3-2**	**sur 4**	**diff 4-3**	**diff 4-1**
Western and Central Africa	2.19	2.24	0.05*	2.29	0.05	2.38	0.09***	0.19***
Benin	1.86	1.99	0.13*	2.22	0.23***	2.17	-0.05	0.31***
Cameroon	2.23	1.97	-0.26***	2.19	0.22**	2.57	0.38***	0.34***
Ghana	1.91	1.94	0.03	2.00	0.06	2.09	0.09	0.18***
Guinea	2.37	2.39	0.02	2.32	-0.07	2.67	0.35***	0.3***
Mali	2.34	2.78	0.44***	2.54	-0.24**	2.79	0.25***	0.45***
Nigeria	2.66	2.46	-0.2*	2.26	-0.2***	2.46	0.2***	-0.2*
Senegal	2.18	2.19	0.01	2.20	0.01	2.19	-0.01	0.01
Eastern Africa	1.85	2.08	0.23***	2.11	0.03	2.25	0.14***	0.4***
Ethiopia	2.34	2.32	-0.02	2.39	0.07	2.54	0.15	0.2**
Kenya	1.37	1.43	0.06	1.55	0.12*	1.62	0.07	0.25***
Malawi	2.05	2.10	0.05	2.31	0.21***	2.20	-0.11**	0.15***
Rwanda	1.95	1.77	-0.18***	1.46	-0.31***	1.44	-0.02	-0.51***
Tanzania	NA	2.28	NA	2.12	-0.16*	2.14	-0.16	NA
Uganda	2.07	2.33	0.26***	2.56	0.23***	2.79	0.23***	0.72***
Zambia	1.95	2.13	0.18***	2.45	0.32***	2.76	0.31***	0.81***
Zimbabwe	1.68	1.91	0.23***	1.95	0.04	2.17	0.22***	0.49***
Asia and the Middle East	1.31	1.17	-0.14***	1.34	0.17***	1.23	-0.11***	-0.08***
Armenia	1.20	1.19	-0.01	1.17	-0.02	1.29	0.12***	0.09***
Bangladesh	0.94	0.89	-0.05**	0.87	-0.02	0.99	0.12***	0.05**
Cambodia	1.79	1.85	0.06*	1.89	0.04	1.93	0.04	0.14***
Egypt	0.93	0.81	-0.12***	0.90	0.09***	0.84	-0.06**	-0.09***
Indonesia	1.15	1.15	0.0	1.09	-0.06**	1.10	0.01	-0.05*
Jordan	1.63	1.60	-0.03	1.50	-0.1*	1.66	0.16***	0.03
Nepal	0.94	0.90	-0.04	0.89	-0.01	0.91	0.02	-0.03
Philippines	1.45	1.50	0.05	1.48	-0.02	1.44	-0.04	-0.01
Latin America and the Caribbean	1.14	1.27	0.13***	1.25	-0.02	1.32	0.07*	0.18***
Colombia	0.82	1.04	0.22***	1.09	0.05**	1.05	-0.04	0.23***
Haiti	1.46	1.49	0.03	1.42	-0.07	1.58	0.16***	0.12*

Notes: sur 1 to 4 indicates the survey number from oldest to most recent for each country as summarized in Table 1. For regions, sur 1 corresponds to the period 1998-2003, sur 2 is 2004-2008, sur 3 is 2009-2013, and sur 4 is 2014-2019.
The stars summarize the p-value of the difference (diff) between the surveys: *p<0.05, **p<0.01, ***p<0.001.
NA = not available. For Tanzania, there were no data on sex-specific ideal number of children.

Appendix Table 4 **Percent distribution of ideal minus current number of children (Total, Boys, Girls) among women age 40-49 in the most recent survey with 95% confidence intervals**

	Total			Boys			Girls		
Survey	Unwanted fertility (Ideal < current)	Ideal = current	Unrealized fertility Ideal > current	Unwanted fertility (Ideal < current)	Ideal = current	Unrealized fertility Ideal > current	Unwanted fertility (Ideal < current)	Ideal = current	Unrealized fertility Ideal > current
Western and Central Africa	21.7 [20.7, 22.6]	16.3 [15.6, 17.1]	62.0 [60.9, 63.1]	32.3 [31.3, 33.4]	21.4 [20.5, 22.3]	46.3 [45.2, 47.4]	34.6 [33.6, 35.6]	22.4 [21.6, 23.3]	43.0 [41.9, 44.1]
Benin 2017-18	27.5 [25.3, 29.8]	17.5 [15.7, 19.4]	55.1 [52.6, 57.5]	43.5 [41.0, 46.1]	21.6 [19.8, 23.5]	34.9 [32.6, 37.3]	44.2 [41.8, 46.7]	18.7 [17.0, 20.5]	37.1 [34.8, 39.4]
Cameroon 2018-19	16.1 [14.0, 18.4]	16.2 [14.3, 18.2]	67.8 [64.9, 70.5]	31.1 [28.4, 33.9]	22.0 [19.5, 24.7]	46.9 [44.1, 49.8]	31.5 [28.8, 34.3]	22.1 [19.8, 24.6]	46.4 [43.6, 49.3]
Ghana 2014	23.6 [21.3, 26.1]	19.6 [17.6, 21.9]	56.7 [54.0, 59.5]	35.9 [33.0, 38.9]	24.5 [22.0, 27.1]	39.6 [36.7, 42.7]	34.3 [31.5, 37.3]	25.2 [22.7, 27.8]	40.5 [37.8, 43.3]
Guinea 2018	19.4 [16.8, 22.4]	12.0 [10.2, 14.0]	68.6 [65.3, 71.8]	22.0 [19.6, 24.6]	22.7 [20.2, 25.4]	55.3 [52.2, 58.4]	25.4 [22.6, 28.4]	24.5 [22.1, 27.2]	50.1 [46.6, 53.6]
Mali 2018	25.6 [22.5, 29.1]	11.9 [10.1, 14.0]	62.4 [58.8, 66.0]	30.3 [27.1, 33.8]	18.7 [16.2, 21.4]	51.0 [47.5, 54.5]	32.8 [29.6, 36.3]	21.8 [19.3, 24.4]	45.4 [41.8, 49.1]
Nigeria 2018	17.4 [16.3, 18.6]	17.7 [16.7, 18.7]	64.9 [63.5, 66.3]	35.9 [34.5, 37.3]	20.8 [19.7, 21.8]	43.4 [42.1, 44.7]	36.2 [34.8, 37.6]	21.2 [20.1, 22.3]	42.6 [41.3, 44.0]
Senegal 2018	21.8 [18.7, 25.3]	18.6 [15.5, 22.1]	59.6 [55.8, 63.3]	24.5 [20.7, 28.7]	19.2 [16.3, 22.5]	56.3 [52.4, 60.1]	36.1 [32.8, 39.5]	23.9 [20.9, 27.2]	40.0 [36.7, 43.5]
Eastern Africa	33.3 [32.4, 34.2]	18.6 [17.9, 19.3]	48.1 [47.1, 49.1]	38.7 [37.8, 39.6]	24.6 [23.8, 25.4]	36.7 [35.8, 37.6]	39.1 [38.2, 40.0]	24.5 [23.7, 25.3]	36.5 [35.5, 37.4]
Ethiopia 2016	33.2 [29.7, 36.9]	13.5 [11.3, 16.0]	53.4 [49.4, 57.3]	33.0 [30.0, 36.1]	21.4 [18.8, 24.4]	45.6 [42.0, 49.2]	36.4 [32.9, 40.1]	21.2 [18.6, 24.2]	42.3 [38.7, 46.0]
Kenya 2014	41.4 [38.8, 44.1]	24.9 [22.6, 27.2]	33.7 [31.3, 36.2]	46.2 [43.6, 48.9]	26.6 [24.3, 29.0]	27.2 [24.9, 29.6]	48.7 [46.1, 51.4]	27.6 [25.2, 30.1]	23.7 [21.5, 26.0]
Malawi 2015-16	42.2 [40.0, 44.4]	22.7 [20.9, 24.5]	35.2 [32.8, 37.6]	41.2 [38.9, 43.6]	27.0 [25.1, 28.9]	31.8 [29.7, 34.0]	41.1 [38.8, 43.4]	27.4 [25.4, 29.5]	31.5 [29.4, 33.8]
Rwanda 2014-15	47.5 [45.3, 49.7]	17.8 [16.1, 19.5]	34.8 [32.6, 37.0]	49.5 [47.3, 51.7]	24.5 [22.8, 26.3]	26.0 [24.2, 28.0]	52.9 [50.6, 55.2]	24.8 [22.9, 26.7]	22.3 [20.6, 24.1]
Tanzania 2015-16	25.4 [23.2, 27.8]	17.7 [15.8, 19.8]	56.8 [54.2, 59.5]	41.8 [39.4, 44.3]	22.6 [20.2, 25.2]	35.6 [32.8, 38.4]	41.6 [39.3, 44.0]	22.0 [19.8, 24.4]	36.4 [33.9, 39.0]
Uganda 2016	38.8 [36.7, 40.9]	14.5 [13.1, 16.2]	46.7 [44.6, 48.7]	41.3 [39.2, 43.5]	20.9 [19.2, 22.8]	37.7 [35.7, 39.8]	39.5 [37.4, 41.7]	21.2 [19.4, 23.1]	39.3 [37.2, 41.4]
Zambia 2018-19	27.0 [24.9, 29.3]	19.9 [18.1, 21.9]	53.0 [50.5, 55.6]	32.5 [30.1, 34.9]	27.1 [24.9, 29.5]	40.4 [37.9, 42.9]	30.6 [28.5, 32.9]	25.4 [23.3, 27.6]	44.0 [41.5, 46.5]
Zimbabwe 2015	15.3 [13.4, 17.5]	20.4 [18.0, 23.0]	64.3 [61.5, 66.9]	27.2 [24.5, 30.0]	27.2 [24.8, 29.8]	45.6 [42.7, 48.6]	26.7 [24.0, 29.6]	27.2 [24.5, 30.0]	46.1 [43.3, 49.0]
Asia and the Middle East	33.3 [32.5, 34.0]	36.2 [35.4, 36.9]	30.6 [29.9, 31.3]	36.9 [36.2, 37.6]	39.3 [38.6, 40.1]	23.8 [23.1, 24.4]	36.0 [35.3, 36.7]	37.3 [36.6, 38.0]	26.7 [26.1, 27.4]
Armenia 2015-16	6.0 [4.8, 7.6]	46.2 [43.3, 49.2]	47.7 [44.8, 50.7]	13.0 [11.1, 15.3]	55.0 [52.1, 57.8]	32.0 [29.3, 34.8]	14.2 [12.4, 16.2]	48.8 [45.9, 51.7]	37.0 [34.4, 39.7]
Bangladesh 2017-18	52.7 [50.7, 54.6]	32.4 [30.7, 34.1]	14.9 [13.7, 16.2]	46.2 [44.6, 47.9]	36.6 [35.1, 38.1]	17.2 [16.0, 18.4]	45.7 [44.0, 47.5]	38.3 [36.8, 39.9]	15.9 [14.8, 17.2]
Cambodia 2014	22.4 [20.6, 24.3]	34.5 [32.6, 36.4]	43.2 [41.2, 45.1]	27.6 [26.0, 29.3]	38.0 [36.2, 39.8]	34.4 [32.7, 36.1]	22.6 [20.7, 24.5]	36.2 [34.3, 38.2]	41.2 [39.1, 43.4]
Egypt 2014	38.5 [36.9, 40.2]	37.8 [36.2, 39.4]	23.7 [22.3, 25.1]	58.0 [56.4, 59.6]	28.0 [26.5, 29.4]	14.1 [13.0, 15.2]	55.6 [54.0, 57.3]	28.9 [27.4, 30.4]	15.5 [14.3, 16.7]
Indonesia 2017	22.9 [21.9, 24.0]	42.4 [41.2, 43.6]	34.7 [33.5, 35.9]	33.9 [32.8, 35.0]	42.3 [41.2, 43.4]	23.8 [22.9, 24.8]	32.1 [31.0, 33.2]	40.5 [39.4, 41.6]	27.4 [26.3, 28.4]
Jordan 2017-18	33.9 [31.6, 36.3]	31.9 [29.7, 34.2]	34.1 [31.9, 36.4]	36.1 [33.8, 38.5]	35.6 [33.5, 37.8]	28.2 [26.3, 30.3]	37.5 [35.2, 39.8]	33.6 [31.6, 35.7]	28.9 [26.9, 31.1]
Nepal 2016	57.4 [54.8, 59.9]	31.1 [28.7, 33.7]	11.5 [10.0, 13.2]	45.1 [42.9, 47.3]	40.5 [38.3, 42.7]	14.4 [12.9, 16.1]	50.7 [48.5, 52.8]	33.8 [31.6, 36.0]	15.6 [14.1, 17.2]
Philippines 2017	31.4 [29.5, 33.3]	33.5 [31.5, 35.6]	35.1 [33.1, 37.2]	35.9 [33.9, 37.8]	38.5 [36.6, 40.4]	25.6 [23.9, 27.4]	29.9 [28.2, 31.8]	38.0 [36.2, 39.9]	32.0 [29.9, 34.2]
Latin America and the Caribbean	38.0 [36.5, 39.5]	27.5 [26.2, 28.8]	34.5 [33.0, 36.0]	42.3 [40.8, 43.9]	36.0 [34.4, 37.6]	21.7 [20.4, 22.9]	38.2 [36.7, 39.7]	35.3 [33.9, 36.7]	26.6 [25.4, 27.8]
Colombia 2015-16	28.4 [26.9, 29.9]	37.1 [35.5, 38.8]	34.5 [32.7, 36.3]	36.0 [34.1, 37.9]	45.9 [43.8, 48.1]	18.1 [16.8, 19.5]	33.9 [32.5, 35.5]	42.0 [40.3, 43.7]	24.1 [22.7, 25.5]
Haiti 2016-17	47.6 [45.1, 50.0]	17.9 [16.1, 19.8]	34.6 [32.3, 36.9]	48.6 [46.2, 51.1]	26.1 [24.0, 28.4]	25.2 [23.2, 27.3]	42.3 [39.8, 44.9]	28.6 [26.5, 30.8]	29.0 [27.1, 31.0]

Appendix Table 5 Percentage of unrealized fertility by country regions among women 40-49 in the most recent survey

Western & Central Africa													
Benin 2017-18	Alibori 46.1	Atacora 76.5	Atlantic 53.0	Borgou 68.8	Collines 45.4	Couffo 63.9	Donga 73.5	Littoral 56.9	Mono 45.6	Ouémé 39.8	Plateau 45.1	Zou 56.9	Total 55.1
Cameroon 2018-19	Adamawa 74.8	Centre (without Yaounde) 69.2	Douala 63.5	East 72.9	Far-North 74.6	Littoral (without Douala) 48.2	North 78.9	North-West 58.9	West 60.4	South 70.5	South-West 62.6	Yaounde 66.9	Total 67.8
Ghana 2014	Western 55.8	Central 54.0	Greater Accra 62.1	Volta 50.9	Eastern 51.4	Ashanti 54.6	Brong Ahafo 52.3	Northern 72.7	Upper East 61.1	Upper West 46.3			Total 56.7
Guinea 2018	Boké 63.0	Conakry 72.6	Faranah 70.0	Kankan 67.2	Kindia 79.5	Labé 51.5	Mamou 59.1	N'Zérékoré 76.9					Total 68.6
Mali 2018	Kayes 52.0	Koulikoro 65.4	Sikasso 63.0	Segou 61.8	Mopti 72.7	Toumbouctou 76.2	Gao 70.7	Kidal 47.2	Bamako 52.5				Total 62.4
Nigeria 2018	North Central 63.9	North East 80.1	North West 75.6	South East 55.8	South South 61.1	South West 47.9							Total 64.9
Senegal 2018	Dakar 62.2	Ziguinchor 69.2	Diourbel 68.9	Saint-Louis 51.5	Tambacounda 68.1	Kaolack 52.0	Thiés 47.3	Louga 61.0	Fatick 60.3	Kolda 68.1	Matam 59.2	Kaffrine 56.3	Total 59.6
	Kedougou 72.5	Sedhiou 57.4											
Eastern Africa													
Ethiopia 2016	Tigray 63.5	Afar 42.3	Amhara 55.6	Oromia 43.5	Somali 88.9	Benishangul 66.2	Snnpr 51.8	Gambela 76.1	Harari 53.6	Addis Adaba 77.1	Dire Dawa 70.8		Total 53.4
Kenya 2014	Coast 42.5	North Eastern 89.5	Eastern 27.1	Central 33.3	Rift Valley 34.9	Western 32.3	Nyanza 23.3	Nairobi 45.3					Total 33.7
Malawi 2015-16	Northern Region 32.5	Central Region 31.6	Southern Region 39.4										Total 35.2
Rwanda 2014-15	Kigali City 34.1	South 34.3	West 31.0	North 37.6	East 36.4								Total 34.8
Tanzania 2015-16	Dodoma 57.9	Arusha 56.9	Kilimanjaro 44.0	Tanga 59.5	Morogoro 55.1	Pwani 77.2	Dar Es Salaam 64.5	Lindi 83.2	Mtwara 67.6	Ruvuma 58.6	Iringa 55.0	Mbeya 58.4	Total 56.8
	Singida 51.9	Tabora 59.3	Rukwa 53.6	Kigoma 55.8	Shinyanga 51.7	Kagera 41.3	Mwanza 61.9	Mara 47.6	Manyara 45.6	Njombe 36.0	Katavi 52.5	Simiyu 55.1	
	Geita 46.4	Zanzibar 68.4											
Uganda 2016	Kampala 57.8	South Buganda 60.4	North Buganda 47.9	Busoga 37.2	Bukedi 35.7	Bugisu 36.7	Teso 37.8	Karamoja 69.5	Lango 37.6	Acholi 33.9	West Nile 52.6	Bunyoro 45.7	Total 46.7
	Tooro 56.1	Ankole 54.5	Kigezi 42.9										
Zambia 2018-19	Central 54.9	Copperbelt 56.0	Eastern 36.3	Luapula 55.3	Lusaka 60.2	Muchinga 41.7	Northern 47.5	North Western 42.3	Southern 65.9	Western 57.4			Total 53.0
Zimbabwe 2015	Manicaland 63.4	Mashonaland Central 71.6	Mashonaland East 68.0	Mashonaland West 69.0	Matabeleland North 58.7	Matabeleland South 48.5	Midlands 58.1	Masvingo 62.7	Harare 67.2	Bulawayo 61.1			Total 64.3

Continued...

Appendix Table 5—*Continued*

Asia and the Middle East													
Armenia 2015-16	Yerevan 50.4	Aragatsotn 56.0	Ararat 39.8	Armavir 39.7	Gegharkunik 48.0	Lori 57.2	Kotayk 47.4	Shirak 49.4	Syunik 45.2	Vayots Dzor 34.7	Tavush 46.4		Total 47.7
Bangladesh 2017-18	Barisal 13.4	Chittagong 9.9	Dhaka 15.8	Khulna 16.7	Mymensingh 16.1	Rajshahi 15.5	Rangpur 17.1	Sylhet 15.9					Total 14.9
Cambodia 2014	Banteay Mean Chey 44.6	Kampong Cham 43.6	Kampong Chhnang 41.7	Kampong Speu 36.2	Kampong Thom 29.2	Kandal 49.8	Kratie 37.6	Phnom Penh 51.8	Prey Veng 48.9	Pursat 45.0	Siem Reap 44.2	Svay Rieng 46.4	Total 43.2
	Takeo 28.8	Otdar Mean Chey 26.0	Battambang & Pailin 49.7	Kampot & Kep 45.2	Preah Sihanouk & Kaoh Kong 46.9	Preah Vihear & Steung Treng 34.2	Mondol Kiri & Rattanak Kiri 39.9						
Egypt 2014	Urban Governorates 28.2	Lower Egypt Urban 21.7	Lower Egypt Rural 20.8	Upper Egypt Urban 24.8	Upper Egypt Rural 25.7	Frontier Governorates (without north and south Sinai) 28.0							Total 23.7
Indonesia 2017	Sumatera 33.2	Java 34.7	Bali/Nusa Tenggara 35.8	Kalimantan 35.0	Sulawesi 36.2	Maluku/Papua 36.3							Total 34.7
Jordan 2017-18	Amman 35.3	Balqa 33.3	Zarqa 30.7	Madaba 37.7	Irbid 34.9	Mafraq 30.0	Jarash 25.2	Ajloun 30.0	Karak 38.8	Tafiela 29.6	Ma'an 40.9	Aqaba 42.6	Total 34.1
Nepal 2016	Province 1 10.6	Province 2 9.3	Province 3 15.1	Province 4 10.5	Province 5 12.8	Province 6 10.2	Province 7 7.2	Total 11.5					
Philippines 2017	Ilocos 37.2	Cagayan Valley 26.0	Central Luzon 38.5	Calabarzon 29.6	Bicol 28.5	Western Visayas 30.3	Central Visayas 39.5	Eastern Visayas 37.7	Zamboanga Peninsula 39.3	Northern Mindanao 39.4	Davao 33.9	Soccsksargen 34.7	Total 35.1
	National Capital 38.2	Cordillera 42.8	Autonomous Region in Muslim Mindanao 49.7	Caraga 36.4	Mimaropa 23.6								
Latin America and the Caribbean													
Colombia 2015-16	Atlantica 41.7	Oriental 35.9	Central 31.6	Pacifica 32.5	Bogota 31.5	Orinoquia/ Amazonia 31.2							Total 34.5
Haiti 2016-17	Aire Métropolitaine 43.2	Rest-Ouest 33.3	Sud-Est 27.4	Nord 34.2	Nord-Est 28.3	Artibonite 37.0	Centre 32.2	Sud 26.3	Grand Anse 21.5	Nord-Ouest 28.7	Nippes 34.3		Total 34.6

Appendix Table 6 Distribution of covariates used in the regression models by region

Variable	Western and Central Africa	Eastern Africa	Asia and the Middle East	Latin America and the Caribbean
Number of children				
0-2	17.8 [17.0, 18.7]	16.5 [15.9, 17.2]	13.3 [12.8, 13.8]	18.1 [17.0, 19.3]
3	11.3 [10.7, 12.0]	12.6 [12.0, 13.2]	23.4 [22.7, 24.2]	23.7 [22.4, 25.0]
4	15.3 [14.6, 16.0]	15.5 [14.9, 16.1]	24.7 [24.1, 25.4]	20.0 [18.8, 21.3]
5	16.6 [15.8, 17.3]	15.9 [15.3, 16.5]	38.5 [37.7, 39.4]	38.2 [36.6, 39.8]
6+	38.9 [37.9, 40.0]	39.5 [38.6, 40.4]		
Number of sons				
0-1	30.8 [29.8, 31.8]	30.7 [29.9, 31.5]	16.4 [15.9, 17.0]	21.2 [20.0, 22.4]
2	23.5 [22.7, 24.4]	25.3 [24.5, 26.0]	33.1 [32.4, 33.9]	31.6 [30.2, 33.1]
3	21.5 [20.7, 22.3]	20.4 [19.7, 21.0]	28.8 [28.2, 29.5]	23.9 [22.6, 25.3]
4+	24.1 [23.3, 25.0]	23.6 [22.9, 24.4]	21.6 [21.0, 22.3]	23.2 [22.0, 24.5]
Number of daughters				
0-1	33.3 [32.3, 34.3]	31.2 [30.4, 32.0]	21.1 [20.4, 21.7]	21.6 [20.3, 22.9]
2	23.8 [23.0, 24.7]	24.3 [23.6, 25.1]	33.7 [33.1, 34.4]	31.7 [30.3, 33.2]
3	20.1 [19.3, 20.8]	19.8 [19.1, 20.4]	24.9 [24.3, 25.5]	24.2 [23.0, 25.5]
4+	22.8 [22.0, 23.7]	24.7 [24.0, 25.5]	20.4 [19.8, 20.9]	22.5 [21.1, 23.8]
Sex composition				
0-3 children	29.2 [28.2, 30.2]	29.1 [28.3, 30.0]	13.3 [12.8, 13.8]	18.1 [17.0, 19.3]
2 sons 2 daughters	5.2 [4.8, 5.6]	4.8 [4.4, 5.1]	13.0 [12.5, 13.6]	12.5 [11.4, 13.7]
4 & sons > daughters	4.5 [4.1, 4.9]	4.6 [4.2, 4.9]	6.5 [6.0, 7.0]	5.5 [4.9, 6.1]
4 & daughters > sons	5.7 [5.3, 6.2]	6.2 [5.8, 6.6]	3.9 [3.6, 4.2]	5.7 [5.1, 6.3]
5 & sons > daughters	8.6 [8.1, 9.2]	8.2 [7.8, 8.7]	13.5 [13.0, 14.0]	10.4 [9.3, 11.5]
5 & daughters > sons	8.0 [7.5, 8.5]	7.7 [7.2, 8.1]	11.3 [10.8, 11.7]	9.6 [8.9, 10.5]
6+ children	38.9 [37.9, 40.0]	39.5 [38.6, 40.4]	38.5 [37.7, 39.4]	38.2 [36.6, 39.8]
Education				
None	60.1 [58.9, 61.4]	26.3 [25.4, 27.1]	22.0 [21.3, 22.8]	20.2 [18.6, 21.9]
Primary	18.6 [17.8, 19.5]	51.7 [50.8, 52.7]	25.5 [24.9, 26.2]	33.4 [31.9, 34.9]
Secondary +	21.3 [20.3, 22.3]	22.0 [21.1, 22.9]	52.5 [51.6, 53.3]	46.4 [44.5, 48.3]
Contraceptive use				
None	84.3 [83.5, 85.1]	61.6 [60.7, 62.4]	50.8 [50.0, 51.5]	53.1 [51.4, 54.7]
Traditional	2.4 [2.1, 2.8]	3.8 [3.5, 4.1]	12.3 [11.8, 12.8]	3.8 [3.2, 4.5]
Modern	13.2 [12.5, 14.0]	34.6 [33.8, 35.5]	36.9 [36.2, 37.7]	43.1 [41.5, 44.8]
Age at first birth				
Less than 20	47.5 [46.4, 48.5]	53.2 [52.2, 54.1]	37.0 [36.3, 37.8]	35.2 [33.7, 36.8]
20-24	32.0 [31.1, 32.9]	34.7 [33.8, 35.5]	40.9 [40.1, 41.7]	37.3 [35.8, 38.7]
25-29	13.7 [13.0, 14.5]	9.4 [8.9, 9.9]	15.3 [14.8, 15.9]	17.1 [15.9, 18.3]
30-49	6.8 [6.2, 7.5]	2.8 [2.5, 3.1]	6.7 [6.4, 7.1]	10.5 [9.4, 11.7]
Exposure to FP messages				
Exposed	43.9 [42.5, 45.2]	45.2 [44.3, 46.1]	46.2 [45.4, 47.1]	53.3 [51.6, 54.9]
Not exposed	56.1 [54.8, 57.5]	54.8 [53.9, 55.7]	53.8 [52.9, 54.6]	46.7 [45.1, 48.4]
Place of residence				
Urban	41.5 [40.2, 42.8]	25.6 [24.8, 26.5]	49.7 [48.6, 50.8]	62.1 [60.3, 63.9]
Rural	58.5 [57.2, 59.8]	74.4 [73.6, 75.2]	50.3 [49.2, 51.4]	37.9 [36.1, 39.8]

Appendix Table 7 Adjusted coefficients from the logistic regressions of unrealized fertility for Western and Central Africa

Variable	Regional	Benin	Cameroon	Ghana	Guinea	Mali	Nigeria	Senegal
Number of children (ref.=4)[1]								
0-2	1.99***	1.95***	2.12***	3.13***	0.28	1.52**	2.44***	2.51**
3	1.02***	1.56***	0.84**	1.44***	0.43	0.02	1.47***	0.78
5	-0.56***	-0.02	-0.56*	-0.68***	-0.57**	-0.82**	-0.38**	-1.54***
6+	-1.38***	-1.16***	-1.44***	-1.50***	-1.52***	-1.74***	-0.94***	-2.37***
Number of sons (ref.=2)[2]								
0-1	0.84***	0.83***	0.90***	1.20***	0.18	0.78**	0.93***	1.11***
3	-0.49***	-0.27	-0.60**	-0.64***	-0.39*	-0.47*	-0.52***	-0.75**
4+	-1.13***	-0.85***	-1.00***	-1.68***	-1.16***	-1.30***	-0.93***	-1.71***
Number of daughters (ref.=2)[2]								
0-1	0.80***	0.55***	0.90***	0.93***	0.34	0.75**	0.86***	1.52***
3	-0.52***	-0.70***	-0.32	-0.87***	-0.74***	-0.31	-0.40***	-0.44
4+	-1.16***	-1.41***	-0.97***	-1.71***	-1.22***	-1.27***	-0.82***	-1.24***
Sex composition (ref.=2 sons 2 daughters)[3]								
0-3 children	1.61***	1.73***	1.56***	2.21***	0.11	1.13**	2.00***	2.00***
4 & sons > daughters	0.29*	0.02	-0.19	0.15	0.32	1.40**	0.20	0.63
4 & daughters > sons	0.19	0.02	0.90*	0.05	-0.89	0.18	0.17	0.93
5 & sons > daughters	-0.45***	0.18	-0.36	-0.66*	-0.75	-0.64	-0.38	-1.16**
5 & daughters > sons	-0.35**	-0.19	-0.41	-0.55	-0.83*	0.03	-0.13	-0.90*
6+ children	-1.22***	-1.15***	-1.26***	-1.42***	-1.73***	-1.26***	-0.82***	-1.86***
Education (ref.=Secondary +)[1]								
None	0.81***	0.41	0.89***	0.94***	0.59*	0.41	0.93***	0.94*
Primary	0.24**	0.03	0.20	0.42*	0.38	0.06	0.21*	0.40
Wealth quintile (ref.=Lowest)[1]								
Second	-0.16*	-0.23	-0.08	-0.30	0.25	-0.10	-0.39***	-0.14
Middle	-0.32***	-0.28	-0.39	-0.61**	-0.05	-0.15	-0.77***	-0.13
Fourth	-0.34***	-0.44*	-0.30	-0.78**	-0.18	0.26	-0.77***	-0.53
Highest	-0.62***	-1.04***	-0.70*	-0.96***	0.10	-0.06	-1.01***	-1.30***
Contraceptive use (ref.=None)[1]								
Traditional	-0.60***	-0.62*	-0.34	-0.27	-0.22	-1.74*	-0.74***	-0.42
Modern	-0.59***	-0.50**	-0.47*	-0.52**	-0.22	-0.24	-0.58***	-1.17***
Age at first birth (ref.=Less than 20)[1]								
20-24	-0.02	-0.07	-0.02	0.04	-0.01	0.22	-0.17*	0.02
25-29	-0.07	-0.04	0.21	-0.11	-0.05	-0.02	-0.13	-0.11
30-49	-0.05	0.17	-0.19	-0.42	-0.33	0.17	-0.10	0.80*
Place of residence (ref.=Urban)[1]								
Rural	0.18**	0.29*	0.31	-0.11	-0.08	0.68*	0.17*	0.43
Exposure to FP messages (ref.=Exposed)[1]								
Not exposed	-0.09	-0.18	-0.05	0.06	-0.44**	0.24	-0.09	-0.17
Country (ref.=Benin)[1]								
Cameroon	0.77***							
Ghana	-0.03							
Guinea	0.25*							
Mali	0.37***							
Nigeria	0.69***							
Senegal	0.18							

Notes:
[1] Estimates from Model 1; [2] Estimates from Model 2; [3] Estimates from Model 3
*p<0.05, **p<0.01, ***p<0.001

Appendix Table 8 **Adjusted coefficients from the logistic regressions of unrealized fertility for Eastern Africa**

Variable	Regional	Rwanda	Ethiopia	Kenya	Malawi	Tanzania	Uganda	Zambia	Zimbabwe
Number of children (ref.=4)[1]									
0-2	2.12***	2.76***	1.24***	2.07***	2.23***	2.65***	2.34***	2.09***	1.98***
3	1.27***	1.20***	1.30***	1.26***	1.65***	1.30***	1.32***	1.20***	1.31***
5	-0.33***	-0.43*	-0.10	-0.87***	-0.58**	-0.58**	-0.10	-0.35	-0.22
6+	-1.39***	-1.39***	-0.92***	-1.46***	-1.48***	-1.68***	-1.52***	-1.76***	-1.16***
Number of sons (ref.=2)[2]									
0-1	0.90***	1.29***	0.43	1.20***	1.02***	0.90***	0.83***	1.11***	0.72***
3	-0.55***	-0.29	-0.23	-0.60**	-0.71***	-0.72***	-0.55***	-0.53***	-1.03***
4+	-1.30***	-1.48***	-0.92***	-1.01***	-1.54***	-1.64***	-1.32***	-1.36***	-1.38***
Number of daughters (ref.=2)[2]									
0-1	0.87***	1.27***	0.75***	0.89***	1.03***	0.92***	0.75***	0.62***	0.84***
3	-0.55***	-0.51**	0.01	-0.81***	-0.53***	-1.02***	-0.59***	-0.77***	-0.51*
4+	-1.28***	-1.63***	-0.87***	-1.56***	-1.45***	-1.67***	-1.40***	-1.43***	-1.00***
Sex composition (ref.=2 sons 2 daughters)[3]									
0-3 children	1.66***	1.97***	1.57***	1.65***	2.02***	1.58***	2.03***	1.58***	1.36***
4 & sons > daughters	0.04	0.39	0.92*	-0.11	-0.05	-0.24	0.46	-0.24	-0.48
4 & daughters > sons	-0.01	0.09	-0.07	0.18	0.38	-0.59	0.32	0.16	-0.23
5 & sons > daughters	-0.31**	-0.27	-0.12	-0.70*	-0.64*	-0.66	0.40	-0.37	-0.55
5 & daughters > sons	-0.30**	-0.30	0.59	-0.95**	-0.32	-1.04***	-0.10	-0.37	-0.30
6+ children	-1.36***	-1.24***	-0.62	-1.41***	-1.36***	-1.96***	-1.27***	-1.77***	-1.36***
Education (ref.=Secondary +)[1]									
None	0.71***	0.38	0.37	1.65***	1.11***	0.94**	0.75***	0.32	0.69
Primary	0.43***	0.02	0.05	0.48**	0.83***	0.61	0.45*	0.51**	0.30
Wealth quintile (ref.=Lowest)[1]									
Second	0.02	0.15	-0.28	-0.46*	0.39	-0.31	-0.02	0.32	0.20
Middle	0.03	0.29	-0.12	-0.71**	0.46*	-0.32	0.01	0.48**	-0.25
Fourth	-0.12	0.23	-0.49	-0.56*	0.20	-0.42	0.38*	0.06	-0.74*
Highest	-0.24*	0.27	-0.59	-0.81**	0.21	-0.82*	0.07	-0.09	-0.89*
Contraceptive use (ref.=None)[1]									
Traditional	-0.38**	-0.36	-0.26	-0.60*	0.42	-0.61*	-0.21	-0.20	-0.61
Modern	-0.47***	-0.29*	-0.54**	-0.54***	-0.25*	-0.62***	-0.39**	-0.46***	-0.52***
Age at first birth (ref.=Less than 20)[1]									
20-24	-0.00	-0.39**	0.50**	-0.22	-0.18	-0.23	0.22	0.06	0.00
25-29	-0.09	-0.21	-0.28	0.03	-0.03	-0.08	0.16	-0.16	-0.36
30-49	0.14	-0.29	0.74	0.18	0.29	0.10	-0.42	-0.39	0.43
Place of residence (ref.=Urban)[1]									
Rural	0.12	0.13	-0.27	-0.02	0.03	0.17	0.01	0.14	-0.01
Exposure to FP messages (ref.=Exposed) [1]									
Not exposed	0.12*	0.08	0.33	0.24	0.28*	0.16	-0.01	0.10	-0.11
Country (ref.=Rwanda)[1]									
Ethiopia	1.24***								
Kenya	0.11								
Malawi	0.45***								
Tanzania	1.46***								
Uganda	1.37***								
Zambia	1.49***								
Zimbabwe	1.55***								

Notes:
[1] Estimates from Model 1; [2] Estimates from Model 2; [3] Estimates from Model 3
*p<0.05, **p<0.01, ***p<0.001

Appendix Table 9 Adjusted coefficients from the logistic regressions of unrealized fertility for Asia and the Middle East

Variable	Regional	Nepal	Armenia	Bangla-desh	Cambodia	Egypt	Indonesia	Jordan	Philip-pines
Number of children (ref.=2)[1]									
0-1	2.47***	2.97***	2.18***	3.86***	2.02***	2.78***	2.85***	1.00***	1.96***
3	-0.54***	-0.78**	-0.61***	-0.69***	-0.54***	-0.49***	-0.23***	-0.19	-0.89***
4+	-2.14***	-3.49***	-2.50***	-3.42***	-2.46***	-1.59***	-1.03***	-1.94***	-2.55***
Number of sons (ref.=1)[2]									
0	1.20***	1.57***	1.35***	1.96***	1.07***	0.96***	1.11***	0.78**	1.17***
2	-0.90***	-1.99***	-0.63***	-1.61***	-1.13***	-0.69***	-0.93***	-0.74***	-0.94***
3+	-1.92***	-4.24***	-1.75***	-3.82***	-2.22***	-1.47***	-1.43***	-1.48***	-2.33***
Number of daughters (ref.1)[2]									
0	1.32***	2.10***	1.85***	2.06***	1.08***	1.02***	1.12***	0.53**	1.32***
2	-0.87***	-0.82**	-0.63**	-1.42***	-0.91***	-0.68***	-0.96***	-1.01***	-0.99***
3+	-1.94***	-3.75***	-2.15***	-3.47***	-2.05***	-1.44***	-1.51***	-1.83***	-2.19***
Sex composition (ref.=1 son 1 daughter)[3]									
0-1 children	2.70***	3.18***	2.60***	4.00***	2.10***	2.97***	2.91***	1.15***	2.15***
2 sons 0 daughters	0.58***	0.28	1.23***	0.53**	0.25	0.35	0.20	0.16	0.52
0 sons 2 daughters	0.33***	0.58	0.69*	-0.08	0.15	0.41	0.06	0.43	0.18
3 & sons > daughters	-0.35***	-1.04**	-0.09	-0.69***	-0.57**	-0.37*	-0.15	-0.02	-0.70***
3 & daughters > sons	-0.28***	-0.22	-0.24	-0.40*	-0.36*	-0.25	-0.18	-0.12	-0.70***
4+ children	-1.92***	-3.34***	-2.08***	-3.28***	-2.38***	-1.42***	-0.97***	-1.80***	-2.36***
Education (ref.=Secondary +)[1]									
None	0.32***	1.10***	-	0.11	0.35*	0.03	0.22	0.06	1.24**
Primary	0.14**	0.16	0.70*	0.09	0.22	-0.17	0.06	0.12	0.18
Wealth quintile (ref.=Lowest)[1]									
Second	-0.08	-0.08	-0.12	0.36	0.27	-0.17	-0.17	0.01	-0.49**
Middle	-0.17*	-0.73*	-0.01	-0.09	0.10	-0.36*	-0.23*	0.01	-0.42*
Fourth	-0.08	-0.60	0.10	-0.10	0.34*	-0.59**	-0.23	0.08	-0.42*
Highest	-0.16*	0.19	-0.03	-0.25	0.16	-0.83***	-0.26*	-0.08	-0.46*
Contraceptive use (ref.=None)[1]									
Traditional	-0.27***	-0.17	-0.17	-0.47*	-0.41*	-0.26	-0.65***	-0.25	-0.13
Modern	-0.47***	-0.47	-0.34	-0.73***	-0.37**	-0.55***	-0.78***	-0.39**	-0.31*
Age at first birth (ref.=Less than 20)[1]									
20-24	0.03	0.03	-0.08	-0.01	0.10	-0.04	-0.03	0.26	-0.02
25-29	0.13*	-0.08	0.08	0.28	0.05	0.27	0.15	0.21	-0.02
30-49	0.04	-0.38	-0.20	0.45	0.04	0.34	0.50***	0.26	-0.22
Place of residence (ref.=Urban) [1]									
Rural	0.14**	0.63**	0.20	0.28	0.15	-0.16	-0.01	0.14	0.06
Exposure to FP messages (ref.=Exposed)[1]									
Not exposed	0.01	0.21	-0.14	0.18	0.02	0.10	0.08	-0.04	-0.11
Country (ref.=Nepal)[1]									
Armenia	1.84***								
Bangladesh	0.38***								
Cambodia	2.38***								
Egypt	1.44***								
Indonesia	1.33***								
Jordan	2.59***								
Philippines	1.71***								

Notes:
[1] Estimates from Model 1; [2] Estimates from Model 2; [3] Estimates from Model 3
*p<0.05, **p<0.01, ***p<0.001

Appendix Table 10 Adjusted coefficients from the logistic regressions of unrealized fertility for Latin America and the Caribbean

Variable	Regional	Colombia	Haiti
Number of children (ref.=2)[1]			
0-1	1.79***	1.79***	2.08***
3	-0.68***	-0.73***	-0.71***
4+	-2.51***	-1.70***	-2.79***
Number of sons (ref.=1)[2]			
0	1.16***	1.10***	1.18***
2	-0.87***	-0.94***	-0.82***
3+	-2.08***	-1.85***	-2.18***
Number of daughters (ref. 1)[2]			
0	1.31***	1.26***	1.39***
2	-0.92***	-0.91***	-0.93***
3+	-2.03***	-1.60***	-2.21***
Sex composition (ref.=1 son 1 daughter)[3]			
0-1 children	1.94***	1.90***	2.29***
2 sons 0 daughters	0.39**	0.26	0.67*
0 sons 2 daughters	0.23	0.23	0.24
3 & sons > daughters	-0.51***	-0.62***	-0.45*
3 & daughters > sons	-0.55***	-0.60***	-0.54*
4+ children	-2.35***	-1.58***	-2.57***
Education (ref.=Secondary +)[1]			
None	-0.06	0.61**	-0.07
Primary	0.15	0.17	0.00
Wealth quintile (ref.=Lowest)[1]			
Second	-0.40**	-0.36**	-0.24
Middle	-0.60***	-0.60***	-0.33
Fourth	-0.58***	-0.55**	-0.33
Highest	-0.79***	-0.94***	-0.43
Contraceptive use (ref.=None)[1]			
Traditional	-0.64**	-0.45*	-1.09*
Modern	-0.32***	-0.33***	-0.24
Age at first birth (ref.=Less than 20)[1]			
20-24	0.02	0.02	0.12
25-29	-0.18	-0.16	-0.12
30-49	-0.12	-0.17	-0.06
Place of residence (ref.=Urban)[1]			
Rural	-0.13	-0.02	-0.14
Exposure to FP messages (ref.=Exposed)[1]			
Not exposed	0.06	0.06	0.07
Country (ref.=Colombia)[1]			
Haiti	0.83***		

Notes:
[1] Estimates from Model 1; [2] Estimates from Model 2; [3] Estimates from Model 3
*p<0.05, **p<0.01, ***p<0.001